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ASTM BULLETIN

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This Issue Contains

First Pacific Area National Meeting Outstanding 5–16
Notes on Technical Sessions 8
Notes on Committee Meetings 15
Round-Table Discussion on The Need for Standards for the Inspection of Water-Borne Industrial Wastes, Introduction, *by L. Kermit Herndon* 35
Analysis of Water-Borne Industrial Wastes: The Need for Uniformity in Methods of Analysis and Reporting, *by George D. Beal and S. A. Braley* .. 36
Gaging and Sampling Water-Borne Wastes, *by Charles F. Hauck* 38
Joint Discussion 43
Discussion of Paper on Determining Elongation at Maximum Load in the Tension Test 46
Some Notes on the Effect of Testing Machines on the Tensile Properties of Plastic Films, *by Ladislav Boor* 47
Discussion of Paper on Effect of Speed of Testing Stainless Steel Sheet 53
Ignition and Burning Characteristics of Polyester, Phenolic, and Melamine Fibrous Glass Laminates, *by H. J. Stark* 55
Nomograms for Obtaining the Compound Composition from the Oxide Analysis of Hydrated Limes, *by Ernest M. Levin* 85
Measurement of the Thermal Transmission of Textile Fabrics *by Gerald Winston and Stanley Backer* 62
Discussion of Paper on Visual Rating of Rusted Steel Specimens 67
Spectrographic Methods for Determining Magnesium in Nodular Iron, *by Ford R. Bryan, G. A. Nahstoll, and H. D. Veldhuis* 69
Discussion of Paper on Simplified Preparation of Flat Specimens for Tensile Strength Tests 72
Subject and Author Index to 1949 ASTM Bulletins 73

NEWS ABOUT THE SOCIETY AND ITS COMMITTEES:

Notes on Publications 17
Comment on the Pacific Area Meeting 18
Schedule of A.S.T.M. Meetings ... 18
Standards Aiding Research in the Paint Field—A Case History 19
Over 600 New Members in 1949. 20
Carter S. Cole Dies 20
District Activities 21–24

MISCELLANEOUS NEWS NOTES:

Thermal Insulating Society Organized 28
Book Reviews 27, 28, 78
Committee on Award of Merit 24
A.S.T.M.—Statistical Meeting 24
Technical Committee Notes: New Committee on Chemical-Resistant Mortars; Specifications for Concrete Reinforcement Bars; Adhesives; Textile Activities including Honors to von Bergen and Ashcroft; Shipping Containers; Glass Products; Stainless Steel Pipe 25–28
New Members; Personals; Necrology 29–32
Notes on Laboratory Supplies, Instruments and Catalogs, and News of Instrument Companies 32–34
Index to Advertisers 98

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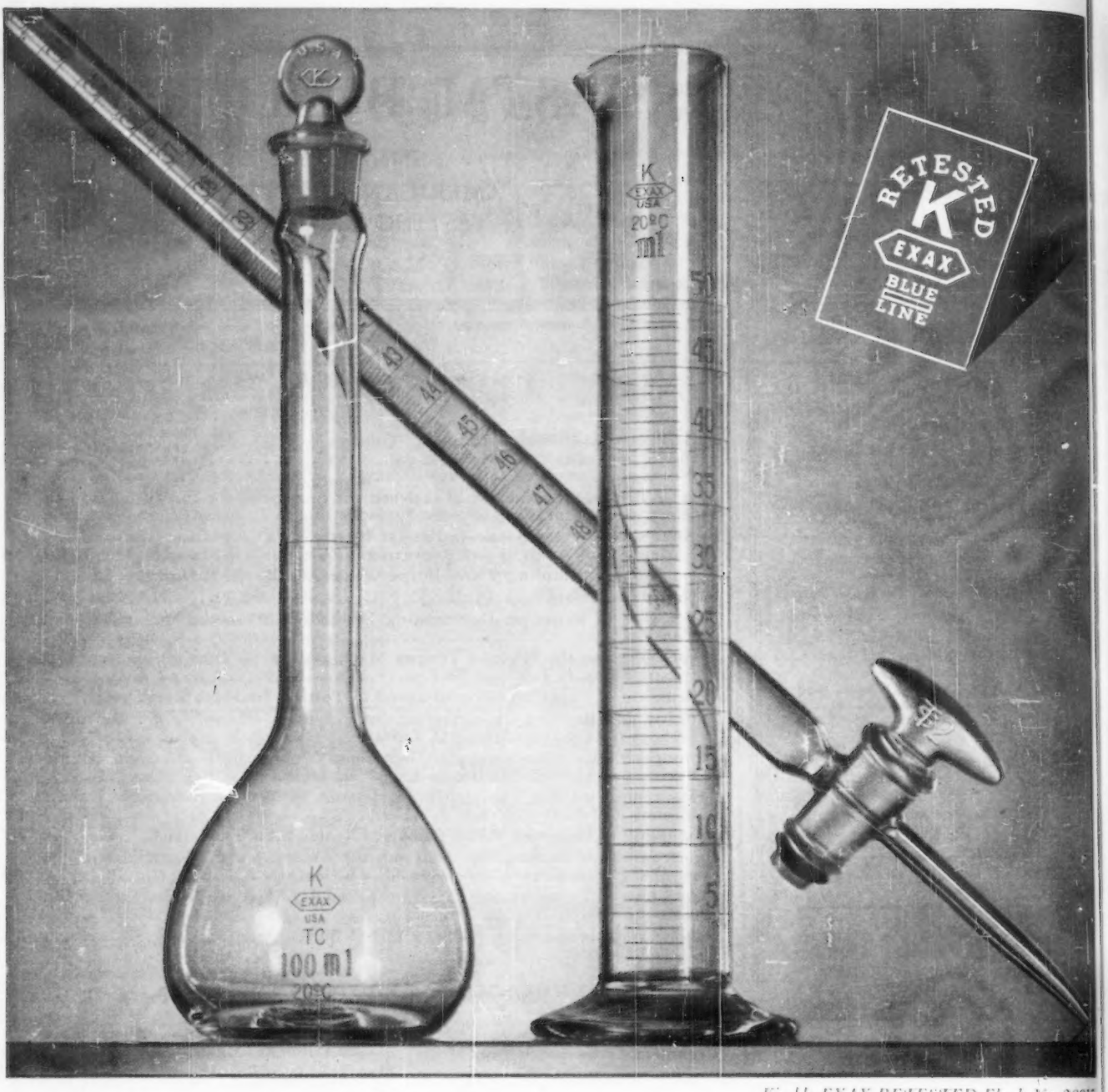
No. 162



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"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

TELEPHONE—Rittenhouse 6-5315 R. E. Hess, Editor R. J. Painter, Associate Editor CABLE ADDRESS—TESTING, Philadelphia

Number 162 DECEMBER, 1949

First Pacific Area National Meeting Outstanding

Technical Sessions, Committee Meetings, Industry Luncheons, Entertainment and Ladies' Events Combined to Provide One of Society's Most Interesting Affairs

THE First Pacific Area National Meeting of the Society held in San Francisco, October 10-14, might now be termed a part of history; but it is the history which one likes to recall. It is history which will call for numerous activities and projects during the coming months, and it is the kind of history which all those in attendance would concur might well repeat itself.

Just how successful such a meeting is considered depends on various factors and viewpoints, but with an attendance of some 700 and an additional 110 ladies; well-attended technical sessions with fine papers, there being fifteen such sessions; many well-attended and interesting meetings of technical committees; plus an outstanding entertainment and social program—this meeting rightly is considered a great success. Unquestionably everyone at it felt amply repaid for the time, effort, and expense in being there.

In carrying through any A.S.T.M. national meeting the leadership, enthusiasm, and work of a local group are always essential. At no other meeting of the Society has there been a larger, more interested, or more efficient working group of members than those who made possible the San Francisco meeting. From its inception there was a realization that members in the West would need to take an important part in various aspects if the meeting was to be successful. That it was so is a direct result of the work of the General Committee on Arrangements and the responsible committees.

Further details of the meeting are given below. Many of the technical papers are to be published, and members will be posted on their appearance and their availability later on.

Kick-Off Luncheon

The opening feature of the meeting was a Kick-Off Luncheon at which there were upwards of 200 present. Chairman Dozier Finley presided and extended greetings. He introduced Mr. Ralph G. Wadsworth, City Engineer of the City and County of San Fran-

At the "Kick-off" Luncheon. L. to r., C. F. Ramey, Standard Oil Co. of California, San Francisco, Secretary-Treasurer, General Committee on Arrangements; W. C. Hanna, California Portland Cement Co., Colton, former member A.S.T.M. Board of Directors, very active in technical committee work, and the oldest member, from point of service, at the meeting; T. P. Dresser, Jr., Abbot A. Hanks, Inc., San Francisco, Board member and very active in the meeting arrangements; C. E. Emmons, The Texas Company, Los Angeles, Vice-Chairman, General Committee on Arrangements, and Chairman, Southern California District; A.S.T.M. President J. G. Morrow, Metallurgical Engineer, The Steel Company of Canada, Ltd., Hamilton, Ont., Canada; Dozier Finley, The Paraffine Cos., Berkeley, Chairman, General Committee on Arrangements, and Chairman, Northern California District; Guest Speaker Ralph G. Wadsworth, City Engineer, City and County of San Francisco; L. J. Markwardt, U. S. Forest Products Laboratory, Madison, Senior Vice-President, A.S.T.M.; R. E. Davis, University of California, Berkeley, Chairman Technical Program Committee; C. L. Warwick, Executive Secretary A.S.T.M.

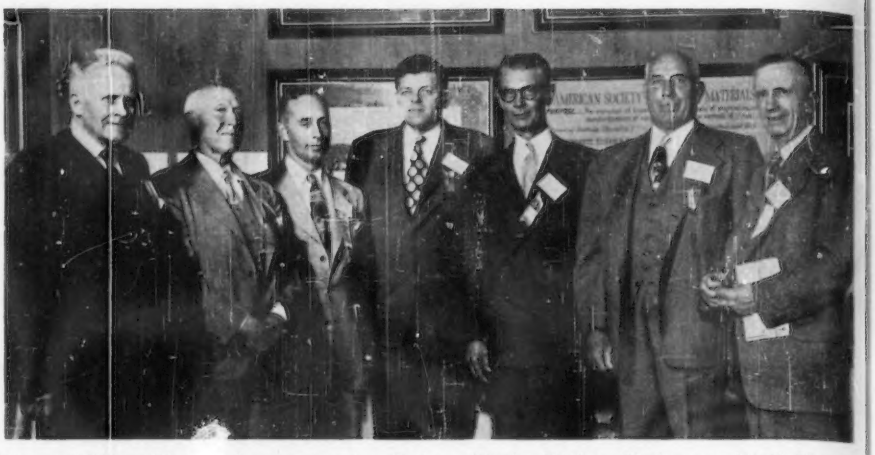
cisco, who gave the address of welcome. It was appropriate that Mr. Wadsworth represented the Mayor who could not attend, because he was quite familiar with the work of A.S.T.M. and in his remarks paid tribute to the Society for its standardization activities, the results of which have been widely used by the City. President Morrow responded in behalf of the Society.

Industry Luncheons

While at A.S.T.M. meetings special luncheons and dinners are frequently held to expedite the conduct of A.S.T.M. business, the five Industry Luncheons which were one feature of the Pacific Area meeting should be particularly noted. They served the multiple purpose of providing eating facilities, an opportunity for those concerned with the industries and subjects to meet in a pleasant social atmosphere and to hear addresses by leaders in their fields or other prominent men. The photographs on the accompanying pages indicate some of the prominent officials and A.S.T.M. members who were at these luncheons. The toastmasters and guest speakers and subjects were as follows:

SOILS LUNCHEON—*Toastmaster:* R. F. Blanks, Chief, Engineering Control and Research Division, U. S. Bureau of Reclamation, Denver. *Guest Speaker:* Evan A. Mattison, Executive Vice-President, Bank of America, San Francisco, on "Growth of the West and Branch Banking."

CEMENT LUNCHEON—*Toastmaster:* J. E. Jellick, Manager, Portland Cement Information Bureau, San Francisco. *Guest Speakers:* A. Allan Bates, Vice-President, Portland Cement Assn., Chicago. R. F. Blanks, Chief, Engineering Control and Research Division, U. S. Bureau of Reclamation, Denver.



General Committee on Arrangements. L. to r., Dozier Finley, Chairman; W. C. Hanna; W. W. Moore; T. K. May; C. F. Ramey, Secretary-Treasurer; C. E. Emmons, Vice-Chairman; T. P. Dresser, Jr. F. F. Blanks was missing, but see other photographs for Mr. Blanks.

PETROLEUM LUNCHEON—*Toastmaster:* H. G. Vesper, President, California Research Corp., San Francisco. *Guest Speaker:* E. A. Evans, President, The Institute of Petroleum (Great Britain), London.

PAINT LUNCHEON—*Toastmaster:* G. J. Grieve, Technical Director, Pacific Paint and Varnish Co., Berkeley. *Guest Speaker:* G. B. Gillin, Superintendent, San Francisco Mint on "Making Money the Hard Way."

WOOD LUNCHEON—*Toastmaster:* T. K. May, Director of Technical Service, West Coast Lumbermen's Assn., Portland. *Guest Speaker:* J. J. Gould, Consulting Engineer, San Francisco on "Timber Research Problems."

Attendance at the luncheons ranged from about 50 to over 200.

Attendance

The attendance figures noted below do not include many who attended technical sessions and committee meetings without registering at the meeting, so that the grand total of 807 is not the total number at the meeting. Undoubtedly there were at least one thousand men at the sessions or committee gatherings.

SOME MEETING ATTENDANCE STATISTICS

Summary of Registrations

Members	298
Visitors	381
Students	15
	694
Ladies	113
Grand Total	807

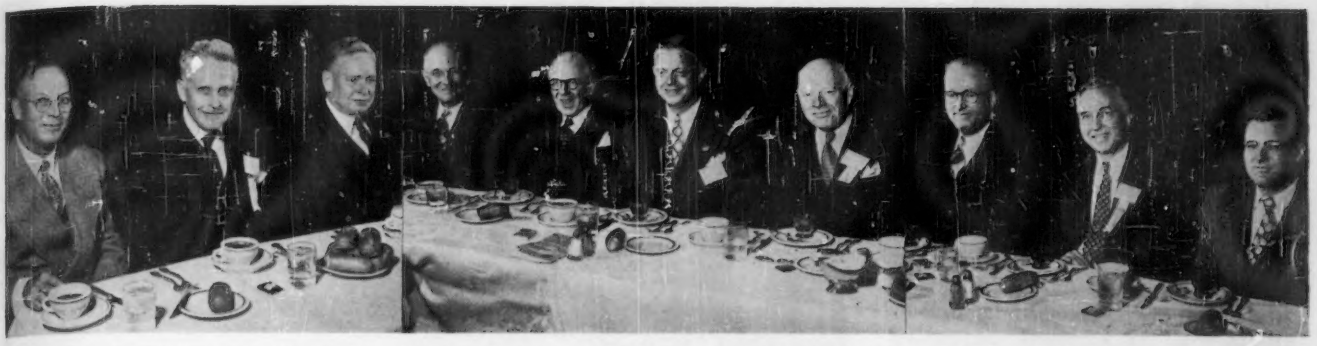
Geographical Classification of Members and Visitors

East of Mississippi River	149
West of Mississippi River	519
Outside Continental United States	11

California was far in the lead on registrants, totaling just over 450, with Illinois and New York next, followed by Pennsylvania, Washington, District of Columbua, Colorado, and Ohio. Five were from Canada, and others from England, Norway, and Sweden.

Hard-working Chairmen of Committees. L. to r., F. M. Harris, Registration; H. A. Sawin, Entertainment; T. K. Cleveland, Publicity; G. E. Solnar, Jr., Dinner and Luncheons; R. E. Davis, Technical Program; S. L. Davidson, Hotel; S. A. Abrahams, Plant Visits; P. V. Garin, Transportation. Messrs. T. S. Hersey and G. L. von Planck, Chairmen of two very important committees, could not be located but were corralled later. See accompanying print.

At the left, T. S. Hersey, Chairman, Liaison and Detailed Arrangements, and right, G. L. von Planck, Chairman, Finance Committee



At the Petroleum Luncheon, Wednesday, Oct. 12. L. to r.: H. Y. Hyde, Vice-President, Tide Water Associated Oil Co.; Dozier Finley, The Paraffine Companies; G. L. Parkhurst, President, Oronite Chemical Co. and Vice-President, Standard Oil Company of California; L. F. Bayer, Vice-President, Tide Water Associated Oil Co.; Dr. E. A. Evans, Guest Speaker from England, President of the Institute of Petroleum, Chairman of its Standardization Committee, and recently elected Vice-Chairman of the Automobile Division, The Institution of Mechanical Engineers; H. G. Vesper, Toastmaster, President, California Research Corporation; J. G. Morrow, President, American Society for Testing Materials; G. A. Davidson, Vice-President, Standard Oil Company of California; C. L. Warwick, Executive Secretary, American Society for Testing Materials; A. J. Johnson, Vice-President, Shell Development Co.

Technical Sessions

IN ADDITION to the fifteen technical sessions at the meeting which had been arranged through the channels of the Committee on Technical Program headed by Prof. R. E. Davis, University of California, there were five other series of papers arranged as sessions which were developed through the work of A.S.T.M. technical committees. Committee D-2 on Petroleum Products and Lubricants was particularly active in this respect, sponsoring an interesting Symposium on Modern Chemical and Instrumental Methods for the Determination of Metals in Petroleum Products and another one dealing with The Effect of Fuel Upon Diesel Engine Deposits. In addition, the committee arranged for an interesting lecture, "The World's Greatest Oil Hobby" by Frank W. McCurry, Vice-President, Derby Oil Co., Wichita, Kans. Committee C-9 arranged a series of papers on Concrete and Concrete Aggregates and Committee D-7 on Wood sponsored a papers session. Committee C-19 on Structural Sandwich Constructions also arranged for three papers in its field.

A list of the technical sessions follows:

Opening Session
Soils
Plasticity and Creep of Metals
Fatigue of Metals
Bituminous Paving Mixtures
Dynamic Stress Determinations
Ceramic and Concrete Products
Application of Statistics
Cement and Concrete, including Symposium on Use of Pozzolonic Materials
Petroleum: Symposium on High Additive Content Oils
Petroleum: Symposium on Turbine Oils
Paint (2)
Wood
Cast Iron

All of the sessions including those sponsored by committees were well attended.

Much could be written about the sessions—that they were truly equal in significance to those sponsored at the annual or spring meetings; that the authors and chairmen presiding carried out their assignments in excellent fashion, etc. The splendid cooperation of authors in furnishing their duplicated papers at the meeting certainly should be noted. A complete set of papers aggregating several hundred pages weighed a good many pounds and was about two and a half feet deep. This will give some idea of the volume of material when multiplied by the some two hundred copies that each author furnished. The availability of the papers stimulated attendance and interest in the sessions. It is expected that a number of the symposiums and groups of papers will be published.

A separate section of this article entitled "Notes on Sessions" is an attempt to provide some news on the sessions and to provide, all to sketchily it is feared because of space limitations, some of the conclusions or points stressed by the authors.

A strong technical program makes for a successful meeting, and the fact that down through the years A.S.T.M. meetings have been successful, including this first Pacific Area National Meeting, bespeaks the excellence and quality of the program.

Entertainment and Social Events

FROM the early stages those responsible for the general arrangements had felt that an interesting program of entertainment and social events should be planned so that all those at the meeting, but particularly the men and ladies from east of the Mississippi, would have an opportunity to enjoy some of the fine facilities offered by the San Francisco area. Under the direction of H. A. Sawin, Chairman of the Committee on Entertainment, there was developed one of the finest programs that one might wish for. It is not possible or necessary to describe each event, but those who participated enjoyed every affair to the limit, and from the many compliments received Mr. Sawin and his group should have had real gratification. Much work was involved because transportation had to be provided in many instances, but things went off without a hitch. George E. Solnar, Chairman of the Dinner Committee, cooperated closely in connection with the Cocktail Party and President's reception, and also handled the Industry Luncheons referred to elsewhere. The success of these affairs is a result of the excellent work of this group.

A list of the entertainment and social events, not including the Industry Luncheons, follows:

Kick-Off Luncheon
Scenic Tour[1]
St. Francis Yacht Club Luncheon and Flower Show[1]
Cocktail Party, President's Reception, Buffet Supper
Luncheon and Fashion Show[1]
Stanford University Tour[1]
Boat Ride, Supper and Entertainment on San Francisco Bay
University of California Trip

Technical Committee Meetings

Several of the A.S.T.M. technical committees held meetings during the week of October 10. All told there were about 63 meetings of the main committees, subgroups, and technical divisions. A list of the main technical committees which met follows:

C-1 on Cement
C-7 on Lime, C-12 on Mortars for Unit Masonry, and C-15 on Manufactured Masonry Units

[1] Primarily Ladies' Events.

C-9 on Concrete and Concrete Aggregates
C-19 on Structural Sandwich Construction
D-2 on Petroleum Products and Lubricants
D-4 on Road and Paving Materials
D-7 on Wood
D-8 on Bituminous Waterproofing and Roofing Materials
D-18 on Soils for Engineering Purposes

In general the committee meetings were well attended, and some, particularly the cement, concrete and petroleum groups, had an excellent turnout of members and visitors. It is believed that every visitor who attended one or more of these meetings gained an insight into the operations of the committees.

Some of the ladies who attended the meeting. This group was at the Luncheon and Flower Show at the St. Francis Yacht Club, San Francisco, Tuesday, Oct. 11.

General Committee on Arrangements

Pacific Area National Meeting

DOZIER FINLEY, *Chairman*, Research Consultant, Berkeley

C. E. EMMONS, *Vice-Chairman*, The Texas Company, Los Angeles

C. F. RAMEY, *Secretary-Treasurer*, Standard Oil Co. of California, 225 Bush St., San Francisco 20

R. F. Blanks, U. S. Bureau of Reclamation, Denver
T. P. Dresser, Jr., Abbot A. Hanks, Inc., San Francisco
W. C. Hanna, California Portland Cement Co., Colton
T. K. May, West Coast Lumberman's Assn., Portland
W. W. Moore, Dames & Moore, San Francisco

Committee Chairmen

Technical Program—R. E. Davis, University of California, Berkeley.
Hotel—S. L. Davidson, National Lead Co., San Francisco.
Registration—F. M. Harris, Pacific Gas and Electric Co., San Francisco.
Transportation—P. V. Garin, Southern Pacific Co., San Francisco.
Entertainment—H. A. Sawin, Yuba Manufacturing Co., San Francisco.
Plant Visits—S. A. Abrahams, The Paraffine Cos., Inc., Emeryville.
Dinner—G. E. Solnar, Jr., Clay Brick Mfrs. Assn. of Northern California, San Francisco.
Publicity—T. K. Cleveland, Philadelphia Quartz Co. of California, Berkeley.
Finance—G. L. von Planck, Columbia Steel Co., San Francisco.
Liaison and Detailed Arrangements—T. S. Hersey, Hersey Inspection Bureau, Oakland

Notes on Technical Sessions

(In order of presentation)

Soils Session:

Three papers were presented at the technical session on soils which dealt principally with the investigation of soil deposits and consolidation and compaction problems. This session, the first of the 15 at the Pacific Area Meeting, was opened by Professor R. E. Davis, chairman of the Committee on Technical Program and honorary chairman who, after extending greetings to those present, turned the meeting over to Professor F. J. Converse.

The first paper entitled, "The Effect of Rock Content and Placement Density on Consolidation and Related Pore Pressure in Embankment Construction," by H. J. Gibbs, Bureau of Reclamation, was presented by W. G. Holtz, also of the Bureau. The paper described laboratory tests for the analysis of materials including coarse size particles up to 3 in. which were used in connection with the problem of consolidation and stability with resulting high pore pressures in the construction of the Jackson Gulch Dam. It was concluded in this paper that the testing procedure used proved applicable for demonstrating the actions of consolidation and pore pressure development in soil-rock mixtures. The probability of high pore pressure decreases considerably as the amount of rock is increased.

A second paper also had its source at the Bureau of Reclamation and was presented by E. A. Abdun-Nur, coauthor with D. Wandland. This paper, "Electrical Resistivity Method Applied to the Investigation of Construction Materials Deposits," described the method as applied for investigating deposits of rock and gravel in the plains area. Examples of actual investigations demonstrated the usefulness of this method in supplementing and guiding drilling in the exploration of such deposits. The authors attempted to show that the resistivity method supplemented by a limited amount of drilling or test pitting furnishes adequate data to permit mapping such materials deposits as a basis for a realistic estimate of the quantities, in a shorter time and at less cost than other currently used methods of exploration.

The final paper entitled, "Studies of Construction Problems and Methods of Compacting Different Type Soils to Optimum Density," by A. W. Root and W. S. Maxwell of the California Division of Highways, was presented by Mr. Root. This paper described briefly several recent studies of various phases of compaction attainment and control of construction projects. It was pointed out that the postwar construction programs of various agencies have stimulated the design and production of new compacting equipment. Several of these new units were discussed and limited data were presented to indicate their efficiency in comparison with conventional equipment. It is felt that the increased efficiency of improved compacting equipment should effect more thorough compaction without increase in construction costs and ultimately may result in revisions of present standards of compaction.

Both prepared and informal discussion took place on all papers presented.

Sessions on Plasticity and Creep of Metals

A session consisting of four papers was held on October 10, 1949, with J. E. Dorn as chairman and Society President James G. Morrow as honorary chairman. An interesting paper was presented by J. W. Freeman of the University of Michigan on "Super Creep-Resistant Alloys." "Super alloys" have been popularized with the advent of the jet engine. Their development has been based on the need for alloys to withstand extreme stresses in the high-temperature components of gas turbines. Their main characteristic is higher creep resistance than was available from practical alloys in 1941 at temperatures above 1200 F. Hundreds of alloys have been made and tested and from a

composition standpoint may be considered as the following types:

1. Modifications of the standard austenitic steels by adding molybdenum, tungsten, columbium, and titanium.
2. Additions of titanium and aluminum to chromium-nickel-iron and chromium-nickel-base alloys as age-hardening agents.
3. Cobalt-chromium-base alloys containing substantial additions of such elements as molybdenum, tungsten, and columbium.
4. A number of alloys have been reported for such elements as carbon, manganese, tantalum, and boron and appear to add substantially to creep strength.
5. Experimentally much effort has been devoted to higher melting point alloys such as the chromium-base alloys, although they remain as yet experimental due to deficiencies in characteristics other than creep resistance.

The paper on "Use of Creep Data in Design" by H. C. Cross, and L. R. Jackson, Battelle Memorial Institute, described the creep data available at the present time and discussed the limitations in interpolation and extrapolation of the data. It indicates the types of additional data which would be of greatest usefulness in the design problems confronting designers in the use of metals for high-temperature service.

A paper on "Application of Forming Criteria to Production Problems" by William Schroeder, Lockheed Aircraft Corp., covered deep drawing, bending, shrinking, stretching, and general considerations, including loss of generalized stress and strain and of fracture, principles of dimensional similarity, and classification of parts and forming operations.

"Experimental Exploration of Plastic Flow in Sheet Metals" by L. R. Jackson, and W. T. Lankford, Carnegie-Illinois, pointed out that the development of experimental data suitable for allowing a choice to be made among various theoretical possibilities has not kept pace with the development of mathematical theories of plastic behavior. The author pointed out that "when anisotropy in real materials is taken into account some of the current theory appears to correlate flow results very well both in accounting for the stress required to maintain flow and in describing the distribution of strain resulting from various stress systems."

Professor Dorn organized the two sessions on plasticity and creep, and on fatigue.

Sessions on Fatigue of Metals

Past-President R. L. Templin acted as chairman of the session on Fatigue of Metals which was presented on October 10, 1949. The introductory paper of this group of four was presented by R. E. Peterson, Westinghouse Electric Corp., and was entitled "Discussions of a Century Ago Concerning the Nature of Fatigue and Review of Some of the Subsequent Researches Concerning the Mechanism of Fatigue." This interesting paper presented a description of a meeting of the Institution of Mechanical Engineers held in Birmingham, England, in 1849. The remainder of the paper included a discussion of early work concerning the nature of fatigue, metallographic studies, X-ray methods, application of the electron microscope, and research at elevated temperatures.

Mr. M. H. Weisman, North American Aviation, Inc., presented a paper entitled "Fatigue Strength of Steel Through the Range from ½ to 30,000 Cycles of Stress." This paper presented a compilation of published fatigue tests on steel which included data for lifetimes of less than 50,000 cycles. In addition, test results which provide data for the range of life from ½ to 30,000 cycles were presented for steels heat treated to 200,000 psi. tensile strength.

"Fatigue Characteristics of Aircraft Materials and Fastenings" by T. E. Piper, Northrop Aircraft, Inc., presented five conclusions:

1. Methods of evaluation of the fatigue characteristics of aircraft materials and fastenings must undergo drastic revision.
2. The establishment of significant criteria upon which realistic design can be based must necessarily be preceded by extensive tests involving uninterrupted dynamic test procedures.
3. So-called natural discontinuities of metallic structures are of growing importance to the students of ultra-high frequency loading.
4. It is incumbent on test engineers and metallurgists to forestall serious failures in aircraft resulting from failure to meet the requirements and conditions noted above.
5. It is a foregone conclusion that "experience" is of little value during this time of revolutionary design and material requirements.

H. J. Grover, Battelle Memorial Institute, presented a paper on "Fatigue Notch Sensitivities of Some Aircraft Materials." His paper presented the results of a review of data on fatigue notch sensitivities of a number of materials used in aircraft. While the available information seems inadequate, not only in extent, but also in nature of notch fatigue test investigations, it does suggest that the following principles may apply:

(a) For completely reversed stress loading apply appropriate theoretical stress-concentration factors to fatigue stress of unnotched specimens.

(b) For partly reversed stress loading apply appropriate theoretical stress-concentration factors to maximum stress values for unnotched specimens having the same lifetime at the same nominal mean stress.

Bituminous Paving Materials Session:

This interesting and well-attended evening session consisted of four papers, three of which centered around the subject of triaxial testing as applied to bituminous mixtures. H. E. Davis presided at this session.

The opening paper described the "Corps of Engineers Method for Design and Control of Asphalt Paving Mixtures," by Gayle McFadden and W. C. Ricketts, Office, Chief of Engineers, and presented by R. A. Chrisholm. An extensive investigational program was described for obtaining data that could be used in formulating design criteria for pavements subjected to wheel loads far in excess of those covered by previous designs. The selection of a simple testing device was one

At the Cement Luncheon, Wednesday, Oct. 12. L. to r., R. E. Hess, A.S.T.M. Technical Secretary; T. E. Stanton, California Division of Highways, Sacramento; Herbert Insley, National Bureau of Standards, Washington; W. C. Hanna, California Portland Cement Co., Colton; F. H. Jackson, U. S. Bureau of Public Roads, Washington; R. F. Blanks, Chief, Engineering Control and Research Division, U. S. Bureau of Reclamation, Denver, Guest Speaker; J. E. Jellick, Manager, Portland Cement Information Bureau, San Francisco, Toastmaster; A. Allan Bates, Vice-President, Portland Cement Assn., Chicago, Guest Speaker; L. J. Markwardt, U. S. Forest Products Laboratory, Madison, A.S.T.M. Vice-President; R. E. Davis, University of California, Berkeley, Chairman, Technical Program Committee; T. P. Dresser, Jr., Abbot A. Hanks, Inc., San Francisco, ASTM Director and member, General Committee on Arrangements; J. R. Dwyer, National Bureau of Standards, Washington, D. C.

of the paramount objectives. The Marshall stability machine was used in the laboratory study and the authors concluded that this machine measures in a satisfactory manner both internal friction of the aggregate fraction of the mixture and the adhesion of the asphalt. Satisfactory coordination of data was established between pavement criteria determined in the field and the use of the Marshall machine.

The three papers on triaxial testing included, "History and Theory of Triaxial Testing and the Preparation of Realistic Test Specimens," by V. A. Endersby, Shell Oil Co. This paper represented a report of the Triaxial Institute, a coordinated effort with A.S.T.M. Committee D-4. The author, after giving a brief review of the history of the development of the triaxial test for road work, discussed stress forms in road pavements and the applicability of triaxial methods thereto. One of the primary problems in the general field of bituminous testing is that most current methods of fabricating test specimens did not really produce the properties of field mixes. The author concluded that only kneading or rolling methods are likely to reproduce road conditions. The second paper, "Application of the Triaxial Testing to Bituminous Mixtures by the California Research Corporation Method," by V. R. Smith, was presented by D. E. Stevens. This outlined the theoretical and mathematical considerations underlying the development of the closed-system triaxial compression test. Criteria were presented for rating the suitability of bituminous paving mixes for various traffic conditions with a recommendation for design of all mixed-type bituminous surfaces derived from the use of this testing procedure.

The Hveem Stabilometer was described in a third paper entitled, "Application of the Triaxial Test to Bituminous Mixtures," F. N. Hveem, California Division of Highways. Mr. Hveem reviewed the development of the stabilometer and discussed the underlying principles of the test and its relation to deformation of road surfaces, bases, and supporting soils. The principal and outstanding advantage of the stabilometer is the speed with which tests may be performed. This test has been in use for more than 15 years and a large mass of data exists to demonstrate the correlation between test results and performance of soils, base materials and bituminous surfaces under motor vehicle traffic. The papers presented were augmented with interesting discussion of the subjects covered.

Sessions on Dynamic Stress Determinations

Four papers were presented at the session on Dynamic Stress Determinations which was held on October 11, 1949, under the chairmanship of H. D. Eberhart, University of California. "Survey of Pick-ups for Dynamic Physical Measurements" by G. E. White, Statham Laboratories, Inc., presented the basic principles governing the analysis of the dynamic response of simple measuring instruments with suggestions on the selection of instruments with adequate time and frequency response. The several types of commercially available instruments were described.

K. D. Swartzel, Cornell Aeronautical Laboratory, Inc., described and classified various types of recording methods according to writing means, source of writing power, and type of record produced in his paper entitled "Selection of Recording Equipment for Dynamic Testing." Key factors in choosing equipment were described and a general procedure for making such a choice was outlined.

"Analysis and Interpretation of Dynamic Records," H. C. Roberts, University of Illinois, provided a generalized summary of the problems of analysis and interpretation of the data taken in dynamic tests, particularly with regard to the difficulties ordinarily encountered. General methods for processing data for tabulation and by graphical methods were given; also the effect of some limitations in equipment was given.

The final paper in this interesting session was presented by H. E. Hosticka and Douglas McHenry was entitled "Some Examples of Dynamic Testing in the Field of Materials and Structures." This paper gave examples of rather ordinary applications which the authors classify in a category lying between the very elaborate tests and the very simple dynamic tests, such as the well-known hammer test in which the quality of the material is judged by a rather crude determination of its natural frequency and damping capacity. The examples described are from the records of a large and diversified engineering organization engaged in the construction of dams, power plants, irrigation canals, and related structures. The examples given do not necessarily describe the best instrumentation of the problem, but rather that instrumentation which gave the most economical and yet satisfactory solution to the problem at the time.

Session on Statistics

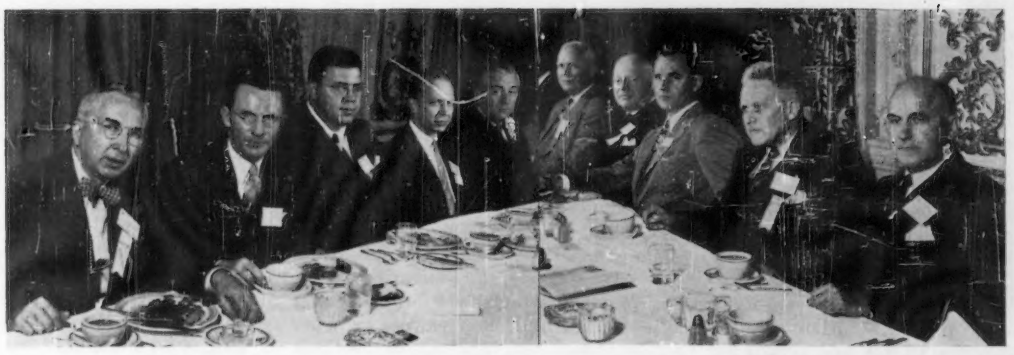
The application of statistical methods in industrial quality control was the subject of three papers presented in a session on October 11 at which Arthur W. Carpenter, B. F. Goodrich Co., and past president of the Society, presided. This session was developed by C. M. Wakeman Los Angeles Harbor Dept. Testing Laboratories.

Quality control, fast becoming an all-important production regulating method, especially during and since the late War, was described in terms of the Economic Relationship Between Design and Acceptance Specifications, by Eugene L. Grant, Stanford University, Calif. After pointing out that a design specification deals with what is desired, while an acceptance specification deals with the means of judging whether what is desired is actually gained, Mr. Grant developed an economic relationship which links them both. Few specified tolerance limits are enforceable, he said, for qualities of manufactured product in the sense that 100 per cent conformity to them can be insured. His paper showed that the design specification should be established and viewed as a problem in economy which cannot be solved without consideration of the acceptance specification. The solving of this problem requires the statistical method and makes use of the tools of statistical quality control.

It is important to know something about the accuracy, precision, and reliability of the physical and chemical tests used by all A.S.T.M. committees to gather data used in their specifications. Grant Wernimont, Eastman Kodak Co., presented the next paper, Precision and Accuracy of Test Methods, and rather thoroughly explained the use of statistical methods for this purpose. Mr. Wernimont emphasized, "It is a waste of time to try to evaluate the precision and accuracy of a test method until it has been shown that the method is reliable." This reliability can be studied by planning a series of determinations so that the individual results can be grouped in some logical way. The variability within these small groups can then be used as a yardstick to determine whether all assignable causes of variation have been properly controlled. The precision of a test method is a measure of how variable the method is when it is used under well-controlled conditions. It is convenient to express precision by means of the standard deviation of individual measurements. The average range within small groups of test measurements can be used to estimate the standard deviation. If the measurements of a test material sample do not differ by more than the random variations of the method, the test method of obtaining those measurements can be said to be accurate. Also Mr. Wernimont showed that reliability, accuracy, and precision can be evaluated for experiment results by the help of statistical control charts.

The Use of Statistics to Determine the Precision of Test Methods was demonstrated by W. J. Youden and J. M. Cameron, both of the National Bureau of Standards. They offered some recent studies on a test method, D 877 – 46 T for the Determination of the Dielectric Strength of Insulating Oils, as an illustration of the types of statistical problems encountered in the study of a test method. Their measurements were examples of a case of nonhomogeneous ones. An exposition was given of a method of taking repeated differences in a set of observations. By this statistical technique the errors of measurement may be isolated from the over-all dispersion which includes sampling and possibly other components. It was pointed out that this may also be done by the analysis of variance technique. This latter method is very useful in ascertaining whether data can be considered homogeneous, they said.

The Johns-Manville Program and Movie on Modern Quality Control was ably presented by Simon Collier. This always meets with an enthusiastic reception and it did so in San Francisco.



At the Paint Luncheon, Thursday, Oct. 13. L. to r., C. L. Warwick, Executive Secretary, A.S.T.M.; L. A. O'Leary, W. P. Fuller & Co., South San Francisco, Chairman, Paint Program, and Vice-Chairman, Northern California District; S. L. Davidson, National Lead Co., San Francisco; R. W. Matlack, George D. Wetherill & Co., Philadelphia, President, Federation of Paint and Varnish Production Clubs; G. B. Gillin, Superintendent, San Francisco Mint, Guest Speaker; G. J. Grieve, Technical Director, Pacific Paint and Varnish Co., Berkeley, Toastmaster; President J. G. Morrow, The Steel Company of Canada; L. L. C. Hanelt, National Lead Co., San Francisco, President, Golden Gate Chapter, The Federation of Paint and Varnish Production Clubs; Dozier Finley, The Paraffine Cos., Berkeley, Chairman, General Committee on Arrangements; C. H. Rose, National Lead Co., Brooklyn, former A.S.T.M. Director, Past-President, Federation of Paint & Varnish Production Clubs and Secretary A.S.T.M. Committee D-1.

Cement and Concrete Session:

Morning and afternoon sessions dealing with cement and concrete were among the best attended of the meeting. The first part under the chairmanship of T. E. Stanton consisted of two interesting papers, one having the title, "Why Type II Cement," by F. H. Jackson, U. S. Bureau of Public Roads, and the other covering the subject, "Long-Time Study of Cement Performance in Concrete, with Special Reference to Heats of Hydration," by G. J. Verbeck and C. W. Foster, Portland Cement Association.

Mr. Jackson calls attention to the fact that in spite of the limitation in scope in the use of Type II cement there has been a marked tendency on the part of many consumers to consider this type as an improved general purpose cement particularly with respect to resistance to severe natural weathering. He discusses the reasons for this trend and that in the observations of the condition of the concrete structures in projects included in the long-time study of cement performance in concrete by the PCA there is little choice between Types I and II in respect to the influence of cement upon durability. In other words, Type II cement is not the answer to the problem of durability of concrete as affected by the cement. The author concludes that continued research on the properties of cement is very necessary as they are affected by composition and by methods of manufacture.

The second paper represented the sixth in a series describing and presenting results from the research project of the P.C.A. This, however, is the first report of this investigation to be presented before the Society. In the absence of the authors the paper was read by I. L. Tyler. The paper as presented covered certain studies in the program dealing with heat of hydration.

The remainder of the session consisted of the presentation of a group of nine papers included in a Symposium on Use of Pozzolanic Materials in Mortars and Concretes. The chairman for this session was R. F. Blanks. These papers covered a wide range of factors affecting the use of pozzolanic materials. The subjects were: a general review of pozzolanic materials and their use in concretes by R. E. Davis, University of California; the experience of the Bureau of Reclamation in the use of pozzolans in mass concrete by H. F. Meissner, Bureau of Reclamation; the experience with pozzolanic materials in Kansas by C. H. Scholer and R. L. Peyton, Kansas State College and Highways Commission, respectively; the effect of calcination on natural pozzolans by R. C. Mielenz, O. J. Glantz, and L. P. Witte, Bureau of the Reclamation (showing that pozzolans of different activity types respond to calcination in a manner reflecting the changes in chemical composition and atomic structure of the active ingredient). Also covered were: the effect of the use of diatomite treated with air-entraining agents upon the properties of concrete by R. E. Davis and Alexander Klein, University of California (in which the conclusion is made that finely ground diatomite treated with a suitable air-entraining agent when used as a small replacement could be employed with benefit in nearly all types of concrete construction, particularly so in pavements); a summary of methods for determining pozzolanic activity by W. T. Moran and J. L. Gilliland, Bureau of Reclamation (the authors being of the opinion that a single short time test will not evaluate pozzolanic activities); strength, volume changes, and sulfate mortars containing portland-pozzolan cement by R. E. Davis, E. H. Brown, of the University of California, and W. C. Hanna, California Portland Cement Co.; a study of some methods of avoiding expansion and pattern cracking associated with the alkali-aggregate reaction by W. C. Lerch, P.C.A. (which emphasized the need for caution in the use of some pozzolanic materials due to their variation in effect upon the prevention of expansion and pattern cracking); and studies of use of pozzolans for counteracting excessive concrete expansion resulting from reaction between aggregates and alkalies in cement by T. E. Stanton, California Division of Highways.

Ceramic and Concrete Products Session:

A session of considerable interest to the general construction field was held on Tuesday, October 11, covering ceramic and concrete products, Arthur W. Carpenter, past-president of the Society, acting as chairman of this session.

A comprehensive paper, "Design and Construction of Reinforced Grouted Brick Masonry," was presented by the author, N. W. Kelch, consulting architect and Technical Director, Brick Manufacturers Assn. of Southern California. Mr. Kelch presented a description of construction procedure and data developed on tests of mortar, grout and brick assemblies. The need was stressed for early development of standard methods for making specimens to be used as check tests on jobs. A paper entitled, "Use of Precast Concrete Units in Southern California," by C. D. Wailes, Jr., Wailes-Bageman Inc., consisted of a general résumé of factors leading to the use of prefabricated and precast elements made of heavy and lightweight concrete. Paralleling the growth of this type of construction must be practical and thorough plant and field inspecting and testing procedures. The author augmented his remarks with a considerable number of photo slides.

A paper on "Some Recent Developments in Vitrified Clay Pipe and Conduit," by H. W. Jewell, Chief Engineer, Pacific Clay Products, was presented by R. B. Stringfield, Consulting Chemist. Efforts to improve the quality of clay pipe and underground conduit was described with emphasis on the importance of specifications and test routine as a check on quality,

control, and value of product. The various test methods used in developing data were outlined including the measurement on rigid structures using electric strain gages. The research work conducted at Ohio State University was referred to in this connection. An interesting feature was the showing of movies depicting the various methods discussed.

The final paper on the program was that of Elmer L. Johnson, Concrete Conduit Co., on "Reinforced Concrete Pipe." After a brief history of the development of reinforced concrete pipe the author outlined the application of the centrifugal process and the problems which were overcome in improving this method of manufacture. With the aid of a motion picture the author demonstrated the Johnson-Prosser method of making reinforced concrete pressure pipe. The conclusion drawn was that the centrifugal process has demonstrated its usefulness in producing a superior product in the reinforced concrete pipe field.

Sessions on Petroleum Products and Lubricants

Committee D-2 on Petroleum Products and Lubricants participated quite actively in the meeting by holding meetings of some 22 subcommittees and sponsoring two formal and two informal symposiums. The attendance at the D-2 subcommittee meetings totaled about 125 members and guests.

The two formal symposiums were held on Wednesday, October 12. The first was devoted to a series of four papers on High Additive Content Oils. This symposium had been arranged by the D-2 Technical Committee B on Lubricating Oils in order to present up-to-date information on additives in high detergency lubricants. The session chairman was A. H. Batchelder, California Research Corp.

The first paper on Does Service Performance Justify Higher Quality Lubricating Oils? was presented by W. B. Bassett, The Lubrizol Corp. The author presented a review of certain service experiences and a limited amount of laboratory engine test data. He realized that the real value of any lubricating oil can only be determined by actual service experience but, at the same time, he pointed out that laboratory data are usually much more reliable for obtaining comparative information on ring sticking and deposit forming tendencies as well as engine wear.

A. B. Boehm, Enjay Co., and C. O. Tongberg, Standard Oil Development Co., presented the paper on High Detergency Motor Oils. The beneficial effect of different concentrations of a detergent additive on the FL-2 performance characteristics of a base oil was illustrated. Light truck and passenger car field tests carried out under rigidly controlled conditions showed that a significant improvement in sludge and ring zone deposits can be obtained by the use of effective combinations of well-refined base oils and low or moderate concentrations of detergent-type additives. In the light truck field tests a high detergency motor oil containing 9 per cent detergent additive showed no advantage over a high-quality heavy-duty oil of lower additive content and detergency level.

Five Years' Experience with Special Heavy Duty Oils was the title of a paper by J. A. Edgar and R. E. Jeffrey, Jr., of Shell Oil Co. The authors agreed that special heavy-duty oils have been outstanding in Diesel engine applications where difficult fuel and operating conditions prevail. The new lubricants offer the possibility of economical use in many Diesel engines over and above the economics to be realized through reduced maintenance, and there are definite indications in natural gas engines that the special heavy-duty oil is of benefit in extending engine life.

The authors concluded that, while gasoline engines do not require an oil of this type, some advantage may accrue to its use in certain types of service, and there seem to be no limiting factors.

In the final paper in this symposium on Possible Future Military Engine Oils, N. L. Klein, Office of Chief of Ordnance, discussed a partial list of military-engine properties, considering present trends in engine design, fuel quality, and operating conditions.

The Symposium on Turbine Oils was held on Wednesday afternoon. Arrangements for this symposium had been made by the D-2 Technical Committee C on Turbine Oils to present current information on the lubrication of turbine equipment. Chairman of the session was T. A. Boyd, General Motors Corp.

In his paper on Lubrication Problems and Requirements of Gas Turbine Equipment, Frank C. Linn, General Electric Co., concluded that:

"1. The temperature of lubricating oil will, in general, be higher on locomotive gas turbines than has been normal for steam turbines that have gone into service during the past twenty-five years for a portion of each year's operation.

"2. It is impractical to change from one lubricating oil to another of different viscosity dependent upon the season of the year.

"3. A double inhibited turbine oil of 150 sec. saybolt viscosity at 100 F. will be best to meet service conditions."

Another interesting paper covered Operating Experience and Problems Relative to Lubricating Systems of Steam Turbine Sets for Utilities, by V. F. Estcourt, Pacific Gas and Electric Co. According to the author, steam turbine lubrication has passed through three definite phases; the first was typified by oils not sufficiently refined for good stability, and operating in bearings with insufficient cooling and excessive moisture infiltration from shaft seals. The second phase was initiated by an effort to produce a more highly refined oil, and this had some unfortunate results in operation due to early breakdown of new oils in the presence of rust from the oil piping, which in turn was the indirect result of over-refining. This was remedied by the introduction of inhibitors, and therefore turbine lubrication today does not present much of a problem due to its very long service life expectancy. However, the ultimate life of a high-grade inhibited oil is not definitely known because insufficient time has not yet elapsed since the advent of inhibitors, and there is reason to suspect that the ultimate breakdown of some inhibited turbine oils may occur rather suddenly.

Though we generally think of steam turbines in terms of generator service for central station usage or for ship propulsion, countless thousands of multi-purpose units find varied applications in industrial plants as generator drives and as prime movers for mechanical equipment, *i.e.*, mechanical drive turbines. The intent of a paper on Specific Problems Pertaining to Lubrication of Industrial Turbines, by A. S. Morrow, Shell Oil Co., was generally to discuss the lubrication problems incident to units in this usage.

After an interesting discussion on factors affecting the design of marine-turbine oiling and propulsion equipment and a review of manufacturing factors, cleaning procedures, and operating techniques, Frederick S. Jones, Socony-Vacuum Oil Co., Inc., in his paper on Lubrication of Marine Turbine Propulsion Equipment concluded:

"The oiling system of marine turbine propulsion equipment is one of the most important parts of the ship. Oil serves to lubricate, it serves as a heat transfer medium, and it serves as a hydraulic fluid. It is highly essential that the oil be kept clean so that it will not take any contamination whatever to the delicate parts of the turbine. If the oiling systems are correctly designed, properly installed and carefully operated by properly trained personnel, marine-turbine propulsion equipment should produce trouble-free operation."

E. A. Mattison, Executive Vice-President, Development of Bank Services, Bank of America, Speaker at the Soils Luncheon

The first informal symposium was held on Tuesday afternoon and was devoted to Modern Chemical and Instrumental Methods for the Determination of Metals in Petroleum Products. This comprised seven papers dealing with current methods used in determining metals in petroleum which included polarographic and photometric determinations, flame photometer

and amperometric determinations, and spectrographic and X-ray absorption. There was an attendance of about 150 at this symposium session and the excellent discussion indicated the intense interest in these new procedures. This symposium session had been arranged by the D-2 Research Division III on Elemental Analysis. The officers of this division, C. M. Gambrill, chairman, Ethyl Corp., and Louis Lykken, secretary, Shell Development Co., served as co-chairmen of the symposium session.

The second informal symposium was held on Thursday, October 13, and dealt with The Effect of Fuel Upon Diesel Engine Deposits. This symposium comprised some six papers on a subject of considerable current interest in view of the increase in the use of Diesel fuels. This symposium had been arranged by the D-2 Technical Committee F on Diesel Fuels and the officers of the technical committee, C. G. A. Rosen, chairman, Caterpillar Tractor Co., and W. G. Ainsley, secretary, Sinclair Refining Co., served as co-chairmen of the session.

An interesting lecture on The World's Greatest Oil Hobby was presented by Frank W. McCurry, Vice-President, Derby Oil Co., on Wednesday evening, October 12, in the Pacific Gas and Electric Auditorium. In connection with his lecture Mr. McCurry displayed a very instructive miniature oil refinery, including drilling rig, flowing oil well, refining units, etc. Arrangements for the lecture were made by Committee D-2. The speaker was introduced by Mr. Robert Matteson, California Research Corp.

Sessions on Paint

There were two sessions on paint held on Thursday, October 13, the first comprising three papers on Aircraft Finishes. The speakers were introduced by L. A. O'Leary, W. P. Fuller & Co., who arranged the session and who served as chairman of the symposium session.

Fire Resistant Finishes for Aircraft by J. A. Jones and R. V. Niswander, Lockheed Aircraft Corp., discussed work directed toward the reduction of aircraft fire hazards through the use of fire-resistant finishes and improved fire-testing procedures. The development of a fireproof coating material known as a refractory insulating shield, similar to putty, was described. The advantages and disadvantages of this material for protection of parts such as oil tanks in the event of an actual fire were graphically described. The effectiveness of a paint-type coating designed to "puff" and form an insulating shield for protection of aircraft materials such as plywood flooring was reviewed. The development of an elevated-temperature testing apparatus for the evaluation of the fire resistance of trim materials was discussed. This apparatus permits the evaluation of flammability up to 860 F. The results are useful in the study of actual fire risks involved.

In the past few years, with the tremendous increase in speeds of the newer types of planes, erosion has occurred on the surfaces of some of these craft during flight through rain. The eroded areas have been principally the surfaces of low-pressure glass cloth-polyester laminates and organic finishes. Because of this, increasing amounts of work are being done on this subject. In this connection, J. K. Grace and G. C. Frey, North American Aviation Inc., presented a paper on Laboratory Testing of Rain-Erosion Resistance of Aircraft Finishes. In this, data from a jet-type rain erosion tester were compared with previously reported data from a whirling-arm tester. Both sets of data indicate that the time required for erosion failure of several plastic materials varies inversely with a large power of the velocity. The specific relation, however, differs greatly for the two testers; the velocity exponent being approximately 18 for the jet tester and 7 for the whirling arm tester, the difference probably being attributable to differences in the mass of the impinging particles and in the rate of particle impingement. It seems desirable to reduce the particle size and impingement rate of jet testers.

Certain plastic laminate configurations and certain organic finishes show markedly better rain erosion resistance in tests than do conventional laminates and finishes.

The third paper on aircraft finishes, Methods of Evaluation of Aircraft Primers, by E. T. Nelson, Douglas Aircraft Co., besides presenting a brief outline of the methods used for evaluating aircraft primers, also described some special properties of a primer which are necessary to satisfy the company's production and service requirements.

The excellent attendance, approximately 200, and the discussion that followed the presentation of each paper gave evidence of the intense interest in the subject of paint finishes for aircraft.

The afternoon session was devoted to a series of papers which discussed new methods for testing paints and paint materials. A very comprehensive paper on Evaporation Rate of Hydrocarbons and Their Mixtures was presented by L. S. Galstaun, Tide Water Associated Oil Co. This paper reported a study of the basic variables which affect the evaporation rate of hydrocarbon substances. The initial investigation was made on a wide series of pure hydrocarbons including representatives of the aliphatics from normal pentane through 2,2,5-trimethylhexane, the aromatics benzene, toluene, M-xylene, P-xylene, and the naphthenes cyclopentane, methylcyclopentane, cyclohexane, and methylcyclohexane.

Composition of the mixture, particularly aromatic content, influences evaporation rate slightly, the aromatic hydrocarbons, as a class, showing lower evaporation rates than other groups, at the same boiling point.

For pure hydrocarbons the evaporation rate is a function of the vapor pressure and heat of vaporization at the liquid temperature, the difference in temperature between evaporating liquid and ambient air, the velocity of air past the evaporating surface, the thermal conductivity of air at ambient air temperature and the area of the evaporating surface.

A paper on Laboratory Tests of Protective Coatings *versus* Service Results was given by W. T. Moran and G. E. Burnett, of the U. S. Bureau of Reclamation. They endorsed the laboratory testing of protective coatings as a worth-while aid to good engineering, but appreciated the need for precaution in attempting to draw final conclusions based on such testing.

The remaining 10 papers in this session were sponsored by Committee D-1 and dealt largely with a review of tests that are being studied in the committee. These included resin and drying oil tests, solvent and thinner tests, optical properties of paint, electrometric testing of paint films, varnish and pigment tests, accelerated corrosion test, traffic paint test, and cold check testing of furniture finishes.

Wood Session:

A session consisting of five papers dealing with properties of wood was held on October 13, with L. J. Markwardt as chairman. An interesting paper was presented by J. A. Liska entitled, "Studies of the Strength of Glued Laminated Wood Construction," A. D. Freas, U. S. Forest Products Laboratory, being the author. The studies were conducted to get data on

At the Wood Luncheon, Thursday, Oct. 13. L. to r., Emanuel Fritz, University of California, Berkeley, Calif.; John J. Gould, Consulting Structural Engineer, Guest Speaker; T. K. May, West Coast Lumbermen's Association, Portland, Ore., Toastmaster; L. J. Markwardt, A.S.T.M. Vice-President, U. S. Forest Products Laboratory, Madison, Wis.; W. E. Wakefield, Canadian Forest Products Laboratory, Ottawa, Ont., Canada.

the relations between strength properties of glued laminated structural members and the factors affecting the strength of such members, in order to establish recommendations for design procedures. Two research programs dealt with curved members and detailed tests of the effects of end joints and knots, respectively. These studies pointed out the need for additional research on such matters as spacing of end joints in laminations, a theory of joint action, the effect of the depth in deep beams, and radial shear. "Predicting Durability of Exterior Plywood" was presented by the author, N. S. Perkins, Douglas Fir Plywood Assn. The author presented data demonstrating the correlation between the durability of exterior type Douglas fir plywood and the percentage of wood failure occurring in laboratory shear experiments subjected to the U. S. Commercial Standard boiling and drying test, followed by breaking in a tension-shear machine. The principal conclusion drawn is that acceptance of wood failures as a criterion of plywood durability has been justified by the industry.

Two other papers dealt with Douglas fir. The first entitled, "The Physical and Mechanical Properties of Second-Growth Douglas Fir," was presented by the author, J. B. Alexander, University of British Columbia. This consisted essentially of a collection of data on standard tests of small clear specimens of virgin-growth Douglas fir and for second-growth Douglas fir of 60-year and 90-year classes. The author stated that if the provisions of standard grading rules for structural timbers are strictly enforced, second-growth Douglas fir will possess adequate strength for heavy structural requirements. The second paper, on "Strength and Related Properties of Old-Growth Douglas-Fir Infected with Fomes Pini," was by J. R. Stillinger, Oregon State College. This discussed a few of the more important properties of old-growth Douglas fir which has been infected with white spot: Tests included in the study were static bending, compression parallel to grain, compression vertical to grain, shrinkage, hardness, and nail holding power. Explanations and interpretations of the data presented were not covered in this paper but are included in a more complete 150-page report.

Professor E. Fritz, University of California, gave a brief résumé of his paper covering studies made on the mechanical properties of second-growth redwood and comparison with virgin timber. Opportunity was provided for discussion of each of the papers presented.

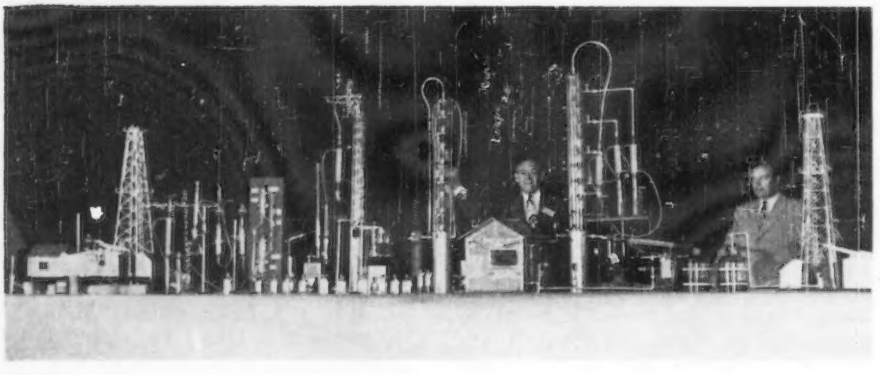
Session on Cast Iron:

Sponsored by Committee A-3 on Cast Iron, with Hyman Bornstein, former Chairman and Secretary of the committee and very active in its work, arranging this session, four papers were presented on October 14. C. K. Donoho, American Cast Iron Pipe Co., covered mechanical testing and properties. Correlations between different test values were reviewed and there were considerable data on nodular graphite irons and the relation of this new iron to other cast metals. He concluded that the position of an iron in the tensile-Brinell chart affords an indication of the graphite form and distribution; a high ratio of tensile strength to hardness gives the greatest toughness as measured by impact testing; properties of nodular graphite cast irons are best evaluated by transverse tests with complete stress-strain curves or by steel-type tensile tests on specimens from keel block coupons; nodular graphite cast irons have tensile-Brinell strength ratios much higher than flake graphite irons and approaching the range of steels, but the compressive strength - Brinell ratio is of the same order whether nodular or flake graphite.

Mr. Bornstein reviewed the development, significance, and uses of specifications, tracing the marked improvement in properties and knowledge of uses of cast irons through the development of standards in which Committee A-3 has taken a leading part. The development of standards frequently indicates a need for research; Committee A-3 had encouraged much research on cast iron. Contrary to the earlier practices, the tensile strength became the primary item in 1932, with seven irons classified ranging from 20,000 to 60,000 psi. He said that even with adequate and proper specifications there is a most important job to be done, and that is to educate the buyer and seller on their proper use. There is a definite trend toward more machinable castings and frequently this is accomplished by a suitable heat treatment. The heat treatment (stress relief or annealing) results in a lower and more uniform hardness range and better machinability. The answer to failures is not always to go to higher strength, but changes in design and improved foundry practice may be equally or more effective. He concluded that specifications for gray iron castings serve a definite need in industry and they should be intelligently used to obtain maximum performance with economy.

The paper on automotive cast iron by R. A. McElwee, Vanadium Corp., which was presented by E. K. Smith, Consulting Metallurgist, Los Angeles, who presided at the session with Mr. Bornstein, indicated that the trend in all automotive irons will be toward higher carbons as foundrymen and engineers realize that a sound casting of 35,000 psi. tensile strength is of greater value than a test bar of 45,000 psi., if the composition of the latter be does not permit making sound castings.

The applications and uses and significance of properties of gray iron were covered by C. O. Burgess, Technical Director, The Gray Iron Founders' Society. He noted that the unique properties of the gray iron which account for its wide use are brought about by graphite flakes which are largely responsible for its castsbility, high yield strength, high compressive and shear strength, unusual wear and corrosion resistance, as well as qualities such as ready machinability, damping capacity, freedom from notch sensitivity, and ability to be hardened without excessive distortion. He referred to the progress being made in using gray iron at elevated temperatures with two A.S.T.M. specifications issued for this service.



Frank W. McCurry, Vice-President, Derby Oil Co., who came from Wichita, Kans., to present his entertaining and educational lecture: The World's Greatest Oil Hobby, and some of the equipment with which he flew to the meeting.

Notes on Committee Meetings During Pacific Area National Meeting

C-1 on Cement:

With an attendance of 50 members and 20 visitors, Committee C-1 on Cement held a full business meeting on October 11, with reports from all subcommittees.

The Working Committee on Chemical Analysis submitted two tables of data comparing flame photometer alkali determinations with gravimetric values. A proposed new tentative method for measuring volume change was accepted for letter ballot of the committee. Thirteen cements have now been sent to collaborating laboratories to be tested for sulfate resistance in accordance with a proposed procedure. In the development of a control test for time of set, one cooperative series of tests has been completed. A shorter and more rapid method for determining the heating of hydration is being considered based on a three temperature reading namely 0-, 20-, and 40-minute intervals. This test will be considered as an alternate to the standard method. A proposed method of test for bleeding of cement pastes in mortars was accepted for letter ballot.

A proposed tentative specification for air-entraining agents with some editorial changes was recommended for acceptance. The air-entraining agent known as "Air-alon" was recommended as being an acceptable air-entraining agent to be so noted in the A.S.T.M. Specifications C 175 T and C 205 T. Cooperative tests are in progress for determining optimum SO_3 content and a tentative method is expected during the next year. The method to be used in a cooperative series of tests on air entrainment has been accepted. This series to be conducted at 14 laboratories will cover nine test conditions and seven cements.

Considerable discussion took place concerning a proposed change in footnote in the Specifications for Portland Cement (C 150) which would suggest the use of compressive strength values over that of tensile strength values when no preference is indicated. Decision on acceptance of this change was deferred pending further collection of data. It was indicated that a cooperative series of tests was needed to develop sufficient information to write a proposed tentative specification on pozzolonic materials. The three types to be considered will consist of: (1) calcine reactive siliceous materials, (2) fly ash, and (3) pumicite.

The Cement Reference Laboratory Subcommittee reported that 40 laboratories had been visited in the southwest and northwest during which time 48 compression testing machines were calibrated disclosing that 50 per cent of these machines needed servicing to meet a one per cent tolerance requirement.

Joint Meeting of C-7 on Lime, C-12 on Mortars for Unit Masonry, and C-15 on Manufactured Masonry:

At the combined meeting of these three committees with J. W. Whittemore presiding as chairman, there was a presentation of three papers covering materials of interest in these fields. Paul Woodworth, Waylite Co., spoke as chairman of the technical committee of the National Concrete Masonry Association, on concrete products used in masonry. He noted that 40 per cent of the total aggregate used in concrete products is now lightweight aggregate. Among other developments in this field it was indicated that there is considerable advancement in precast, prestressed units for beams, columns and full wall sections. Study is being given to shrinkage factors as found in the curing and drying of units in order to minimize the volume change in a wall. For smooth wall appearance, concrete units are now being face ground.

The second paper was presented by E. O. Crocker, Gladding McBean and Co. Mr. Crocker described a new development in building units and construction features—a reinforced grouted ceramic tile facing for buildings which is known as ceramic veneer. One of the interesting features of this construction is a new type of anchoring methods and grout formulations used.

W. M. Chance, Jr., Standard Oil Co. of California, discussed from the consumer's point of view the need for minimizing the cost of construction by the use of manufactured materials and handling equipment. He pointed out that better packaging and palletizing is needed with better means of furnishing materials, starting at the manufacturing plant.

R. S. Boynton, Secretary of Committee C-7, reviewed briefly the activities of his committee noting that the emphasis at present is on the formulation of specifications covering various chemical uses of lime.

C-9 on Concrete and Concrete Aggregates:

Committee C-9 on Concrete and Concrete Aggregates held a meeting of the main committee preceded by meetings of several subcommittees. The main meeting on October 13 consisted of a business meeting and the presentation of several papers on subjects of interest in this field. A total of 75 were in attendance including 27 committee members.

Items reported by subcommittees included a proposed revision of the tentative method for dynamic modulus (C 215 T), these revisions to be completed by the next meeting; a review of the purpose and goal in mind in respect to rocks and minerals as used in concrete; a progress report on the project on thermal expansion of granular materials; and the need for coordination of activities of Committees C-1 and C-9 in testing concrete for the evaluation of air entrainment.

A brief digest of the technical papers presented is as follows: Bryant Mather spoke on methods of testing and specifications for admixtures, giving a summary of his subcommittee's activities which up to now have culminated in the acceptance by the Society of a tentative method of testing air-entraining admixtures for concrete. C. E. Proudley reviewed the various differences in specification requirements found in measuring the quality of nonbituminous liquid compounds for curing concrete. This was presented also as a report of his respective subcommittee. P. M. Woodworth discussed the problems found in the use of lightweight aggregates for concrete which are quite different from those with heavier aggregate. In the use of lightweight aggregates strength is a minor requirement as compared with that of other requirements listing the order of their usage as (1) insulating concrete, (2) nonload-bearing concrete, and (3) structural load-bearing concrete. The final paper was given by Herbert Insley covering the mechanism of expansion following alkali-aggregate reaction in concrete.

The members of the Council of the Southern California District. Seated from l. to r., Vice-Chairman F. J. Converse, California Institute of Technology; Secretary H. W. Jewell, Pacific Clay Products; W. C. Hanna, California Portland Cement Co., former Chairman of the A.S.T.M. Membership Committee, and past member of the Board of Directors; District Chairman C. E. Emmons, The Texas Company. Standing, from l. to r., J. T. Young, City of Los Angeles; R. B. Stringfield, Consulting Chemical Engineer; E. O. Bergman, C. F. Braun & Co.; C. M. Wakeman, Los Angeles Harbor Dept.; A.S.T.M. Assistant Secretary R. J. Painter. N. W. Kelch was also present for a portion of the Council Meeting, held in Los Angeles in October.

D-8 on Waterproofing and Roofing Materials

The Committee on Waterproofing and Roofing products met in San Francisco on October 10, during the Fall meeting of A.S.T.M. on the Pacific Coast. Seven members including the acting chairman, P. E. McCoy, and acting secretary, A. J. Steiner, were present as well as a number of visitors.

Subcommittee activities were discussed and much interest was shown in the subjects of consistency measurement and accelerated weathering tests on roofing products. The cooperative studies going on in these two groups evoked considerable comment.

On consistency, opinion favored two measuring instruments—one suitable for unfilled cutback products, the other for filled products. On weathering, the thought was expressed that less time should be spent on developing a weathering machine which would give reproducible results and more time on developing a machine which would give the same weathering effects as those observed under service conditions.

The need for closer cooperation between subcommittee groups working in different committees on related problems was felt advisable in order to avoid unnecessary duplication of effort.

The use of filter papers in place of cigarette papers for the Stain Test was suggested by one of the members with the thought that the diameter of the ring instead of the number of layers of paper should be used as a rating.

"Informals" on San Francisco

PROBABLY the largest man physically at the meeting was Hotel Committee Chairman *S. L. Davidson* but his activity belied his physique. Dave helped in so many different places and on so many problems at the meeting we can't list them.

T. S. Hersey, Chairman of the Liaison and Detailed Arrangements Committee, undoubtedly knew that his group would have plenty of variety but it is doubtful if he guessed just how much. His committee did many things of tremendous help to the staff, among the most helpful being the transfer by a special truck of the more than two tons of technical papers from Prof. Davis's laboratory where they had been shipped.

Two groups whose work was not greatly heralded in advance were those on Technical Program and Finance. Perhaps the only accolade that Prof. *N. E. Davis's* program group needs is the wonderful reception at the sessions of the various papers. The technical program was of a very high order of excellence.

Meetings cost money, particularly with the rather heavy costs of meeting rooms since San Francisco's policy is to charge for all such rooms, an extensive entertainment program, etc. *G. L. von Planck*, Finance Chairman, planned and carried through the campaign which brought excellent results.

With more functions and more kinds of tickets being sold than at any other A.S.T.M. meeting, the job of keeping track of fees and sales was one most engineers wouldn't like. Perhaps Treasurer *C. F. Ramey* didn't either, although no one would guess from his actions. The complete accounts point to a thorough job here.

Well in advance of the meeting the Publicity Committee headed by *Dr. T. K. Cleveland* arranged for articles to get to the newspapers and the technical and business journals, and as a major campaign sent an attractive poster to hundreds of the engineers and technical people affiliated with various groups and local sections throughout the West. The cooperation of the officers of many societies and trade groups is gratefully acknowledged.

Some ladies learned the value of men's arms when they attempted to walk down Mason Street with high heels and somewhat slippery soles. We didn't try ice skates on the bare pavements but would bet you can glide down some of the grades. It was fun navigating them.

The Los Angeles and Southern California groups were represented in goodly numbers. Emmons, Converse, Kelch, Hanna, Young, Wakeman, and Paine are among the "names" who did much at the meeting.

Chairman Dozier Finley opened the first official function at the meeting, namely the Kickoff Luncheon, with several sharp clangs on a cablecar bell. This was very appropriate indeed and it realized his objective, namely immediate attention of the audience. This little incident typifies many of the thoughtful things which the Chairman of the local Committee on Arrangements did throughout the course of the meeting. A major thing he did was to surround himself with as fine a working committee and subcommittees as we have seen.

Complexities and ramifications of registration details afford the staff many headaches, and it was a distinct pleasure to have all of these absorbed by Registration Chairman *F. M. Harris* and his associates, with the close help of the San Francisco Convention Bureau. A simple statement that "things went off smoothly" perhaps covers completely what we would like to say.

S. A. Abrahams, Sam to his many friends, Chairman of the Committee on Trips, had a very nice potential program arranged which was available to any of the members. While attendance at the technical sessions, committee meetings, and the like prevented heavy participation, certain special visits were arranged, and the University of California all-day tour went off on schedule. The latter included interesting visits through the Engineering Laboratories where Prof. R. E. Davis had his staff available with special placards set up, and, following lunch and a short lecture, the amazing cyclotron up on the hill in back of the Berkeley campus was inspected. Radioactive materials will mean much more now to all who visited the cyclotron; they will realize the tremendous amount and size of equipment involved in production.

The Weather: Well, like chocolate ice cream, there are all kinds of camps—those who like it and those who don't. But the San Francisco weather for the meeting was almost ideal. The vaunted fogs kept a reasonable distance most of the time. But following the meeting many members experienced cold inclement weather both up and down the coast.

Paul Garin, Chairman of the Transportation Committee, and his secretary, were able to help a number of people with travel problems. Too, they aided greatly on several occasions handling the rush for preprints of papers.

A.S.T.M. Committee Week

Hotel William Penn, Pittsburgh, Pa.
February 27–March 3, inclusive.

Numerous technical committees will meet.
Details will be furnished all committee members soon.
Hotel reservation forms will be sent.

Notes on New and Forthcoming Publications

Several Compilations of Standards and Technical Symposiums Issued

THE 1949–1950 publication schedule includes a number of books which will be of interest to wide segments of the members. Several of these have already been issued with notes appearing in the September and October issues of the BULLETIN concerning them. Others have been issued very recently or are scheduled to come off press in the next few weeks. Notes on these appear below. All of these were listed on the Members' Special Order Blank distributed to each member late in November.

Electrodeposited Metallic Coatings:

Up-to-date, and for the convenience of the plating industry, the latest 53-page compilation contained 12 standards prepared jointly by our Committee B-8 on Electrodeposited Metallic Coatings and the American Electroplaters' Society is off press.

The specifications include the tentatives relating to Zinc, Cadmium, Nickel, and Chromium, and Lead Coatings on Steel and the tentative which describes Chromate Finishes on Zinc Surfaces. Another specification is the Standard for Nickel and Chromium on Copper and Copper-Base Alloys. The methods section includes a Local Thickness Test for Electrodeposited Coatings and a Salt Spray Testing Tentative. Two other recommended practices are the Standard for Chrome on Steel for Engineering Use and the Tentative for the Preparation of Low-Carbon Steel for Plating. Cost, to members for the compilation (stiff-paper cover), is 95 cents; to others $1.25.

Symposium on Speed of Testing:

To stimulate further study and improvement of the speed requirements in A.S.T.M. specifications, a symposium was sponsored by the E-1 Subcommittee on Mechanical Testing and presented in June, 1948, at the Fifty-first Annual Meeting of the Society.

Now in a new reprint from the 1948 *Proceedings*, the published symposium includes the five papers and discussions together with a summary containing many data relating to speed effects on a variety of materials. In the papers, steel, magnesium-base alloys, wood, and plastics are covered; testing equipment and methods for speed control are also discussed. In his introductory remarks to the symposium, the importance of speed of testing was indicated clearly by P. G. McVetty: "Tests of some materials are not greatly affected by a considerable variation in testing speed. In others, the acceptance or rejection of a lot of material may depend upon the speed at which acceptance tests are conducted. In one case unnecessary speed restrictions in the specifications would increase the cost of the tests; in the other, lack of suitable speed limitations may result in rejections, delays, and increased cost." Members' price for the stiff-paper covered reprint is 95 cents and non-members' price is $1.25.

Gaseous Fuels Compilation:

For the convenience of those interested in the methods for sampling and analyzing gaseous fuels, a new pamphlet containing three such methods is now available. Sponsored by Committee D-3 on Gaseous Fuels, the pamphlet contains the first method of Test for Caloric Values of Gaseous Fuels by the Water-Flow Calorimeter (D900). This 50-page method, first published in 1946, has been revised and adopted as standard in 1948.

Also after intensive work by the Subcommittees on Measurement of Gaseous Samples and Determination of Specific Gravity and Density of Gaseous Fuels, two new methods have been developed and appear in the pamphlet. These last methods represent the most recent completed items of Committee D-3's big task of covering sampling of gaseous fuels and determination of their most important characteristics.

The 100-page compilation is available to members for 85 cents, and to others for $1.15.

Industrial Water:

A new compilation on methods of testing industrial water has been issued by the Society. For some time Committee D-19 has felt that such a compilation would prove very useful and convenient to members and nonmembers of the Society who are interested in methods of testing and sampling of industrial water. This publication includes twenty-five methods which cover sampling, analysis, corrosivity tests, and methods of reporting. A list of A.S.T.M. Symposiums and Technical Papers on Industrial Water is also included. This compilation consists of approximately 144 pages and is priced at $1.75; members' price, $1.35.

Industrial Aromatic Hydrocarbons:

For the first time, the Society has made available a compilation of the twenty-one methods of testing and specifications under the jurisdiction of Committee D-16 on Industrial Aromatic Hydrocarbons. This booklet comprises specifications for benzene, naphtha, toluene, and xylene as well as methods of testing acidity, acid wash color, copper corrosion, distillation, specific gravity, thiophene, paraffins in, solidifying point of, color, hydrogen sulfide and sulfur dioxide content of aromatic hydrocarbons. This pamphlet consists of 44 pages and is priced at $1.00, list; 75 cents to members.

New List of A.S.T.M. Standards Available

A COMPLETELY revised List of Standards has just been published, and members can obtain a copy of this on request. This pamphlet is used primarily to inform inquirers and others on what specifications and tests have been issued. It does not indicate where the standards are published—this is one of the purposes of the Index to Standards, revised edition of which will be completed late next spring and distributed to each member.

The "List," however, may be a convenience for members' reference now, to ascertain latest designations, etc. When writing ask for a copy of the latest List of A.S.T.M. Standards.

New List of Publications and Members' Order Blank

A NEW List of Publications together with a members' order blank was recently sent to each member. The Publications List describes briefly many of the newer books and revised editions which have already appeared this fall or which are in course of publishing. Several new compilations of standards are described as well as newer editions of existing compilations and there are numerous new symposiums and other Special Technical Publications.

The purpose of the rather extensive members' order blank is to provide a convenient way of placing orders; not only are the special prices to members given but there are brief notes on each book. Committee members not affiliated with the Society are receiving a copy of the List of Publications and a special Committee Members' order form.

Elsewhere in this BULLETIN are descriptions of some of the new books, and members will be kept informed through the BULLETIN and in special mailings of other publications. The Society has an extremely heavy schedule of books including the 1949 Book of Standards which is coming out in six Parts.

There are extra copies of the List of Publications available in case members wish to procure them for distribution to their associates or others.

ASTM Bulletin

DECEMBER 1949

NO. 162

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Our First West Coast Meeting

ELSEWHERE in this BULLETIN appears an account of the highly successful meeting that was recently held on the Pacific Coast. By "successful" we do not have in mind so much the very satisfactory attendance of nearly 700 members and visitors, nor even the strong technical program and the interesting sessions that were held, but rather the over-all significance of the meeting.

Admittedly, the first national meeting to be held in the Pacific Area was approached as something of an experiment to be seen whether such a meeting would be truly "national" or whether it would be largely of a local or "regional" nature, of interest primarily to members and others in the West Coast area. It was both. The program was, naturally enough, partly slanted to be of direct interest to the materials engineers on the West Coast, but the authors of the seventy papers on the program were from all sections of the country (just half from east of the Mississippi), comprising a truly national cross-section of the technical talents in A.S.T.M. Again, while the attendance consisted in large part of individuals from the Pacific Area, there was a goodly number from other sections of the country with about one-fourth from east of the Mississippi and abroad, including a number of the officers and directors of the Society and members of the administrative committees. The meeting was truly a national one in every sense of the word.

In quality, the technical program of 15 sessions compares favorably with those of our annual meetings and was supplemented by five excellent sessions of a less formal nature sponsored by technical committees. There are, of course, many more committee meetings held in conjunction with an annual meeting; but even in this respect the West Coast meeting took on an annual meeting flavor with nearly 60 meetings of ten committees and their subcommittees being held. Of particular interest in this connection was the discussion of special aspects of their work on the part of these committees that would be of interest to the West Coast members. These members and others were thus enabled to bring to the attention of our committees some problems of special local interest, and the committees, on the other hand, were able to present the general nature of their work and to indicate how they are prepared to serve the Society and its membership. In brief, the actual functioning of A.S.T.M. through its committees was on display before members and guests who seldom if ever have the opportunity of participating in this important phase of our activities—to the mutual benefit, we are sure, of both the committees and the members. One could not help but be impressed with the feeling that the meeting was an effective integration of the many and varied interests in the Society.

Much credit for the success of the meeting goes to the hard-working Committee on Arrangements under the able leadership of Dozier Finley, assisted by the members of his committee and by ten subcommittees that handled all assignments in truly magnificent fashion. The names of the General Committee on Arrangements and the chairmen of the committees appear elsewhere in the BULLETIN. The Society, through the Board of Directors, extends sincere thanks to them and their coworkers for the fine service they have rendered to A.S.T.M.

The San Francisco meeting has well demonstrated that with assured interest and effort of local members, with a good technical program, and with the support of a reasonable group of our technical committees, A.S.T.M. can hold a successful national meeting farther from the center of gravity of membership than has heretofore been tried, and in so demonstrating we have again, in a different and yet effective manner, stressed the significance of A.S.T.M. activities in research and standardization.

Schedule of A. S. T. M. Meetings

DATE	GROUP	PLACE
December 12	Committee D-18 on Soils for Engineering Purposes (Executive)	Washington, D. C.
December 14	Philadelphia District	Philadelphia, Pa.
December 16	Committee E-3 on Chemical Analysis of Metals (Editorial)	New York, N. Y.
December 28	Joint Meeting A.S.T.M.—Am. Statistical Assn.	New York, N. Y.
January 24–26 (Tentative)	Committee B-5 on Copper and Copper Alloys, Cast and Wrought	(A.S.T.M. Headquarters)
January 31–February 1	Committee A-1 on Steel	Philadelphia, Pa.
January 31	Philadelphia District	Philadelphia, Pa.
February 16–17	Committee D-15 on Engine Anti-Freezes	Washington, D. C.
February 20–25	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C.
February 27–March 3	COMMITTEE WEEK AND SPRING MEETING	Pittsburgh, Pa.
March 8	Philadelphia District	Philadelphia, Pa.
March (Tentative)	Committee D-20 on Plastics	Cincinnati, Ohio
March 15–17	Committee D-13 on Textile Materials	New York, N. Y.
April 27–28	Committee D-10 on Shipping Containers	Madison, Wis.
June 26–30	53RD ANNUAL MEETING AND 9TH EXHIBIT OF TESTING APPARATUS AND EQUIPMENT	Atlantic City, N. J.

Standards Spearheading Research—Another Case History

Some Examples from the Paint and Varnish Field

THERE are presented below some notes constituting brief case histories of certain problems in the paint and allied industries where standards have had an important part in spearheading research, resulting in the development of improved or new products. This is the third article of this kind, earlier case histories involving the knock testing of fuels, and metallic materials for radio tubes and incandescent lamps having appeared in the September, 1949 (pp. 14–15), and October, 1949 (p. 13), BULLETINS, respectively.

Discussion of the use of standards in the Committee on Developmental Activities, one of the Board of Directors' groups, led to contacts with a number of leading members in the Society, with many extremely interesting case histories resulting. More of these will appear in issues of the BULLETIN.

One of the aims of the committee in presenting this series is to acquaint our members and management with the great significance of standard specifications and tests in spearheading research, with much of this work culminating in products of greater service to the public.

W. H. Lutz, Director of Research, Pratt & Lambert, Inc., Buffalo, N. Y., who sent to the committee the interesting letter printed below, has been active in Society work for a number of years, particularly in Committee D-1 on Paint, Varnish, Lacquer and Related Products. He is also a member of the Administrative Committee on District Activities (a Past-Chairman).

Standards and Research

By W. H. Lutz

THE following examples come to mind of the relationship between test method development and subsequent research that has led to new or better products.

Improvement in house paint:

For years A.S.T.M. Committee D-1 Subcommittee VII, has been studying the accelerated weather testing of protective coatings. As part of this project, paralleling test had to be made under actual conditions of outdoor exposure. Out of all this work has come a knowledge of weather testing methods that would not have otherwise been developed. Techniques have undergone continual refinement as one variable after another has been controlled. This finally culminated in the appointment of Subcommittee XII to develop a method for exterior exposure testing of paint on wood.

With the more exacting test methods that have evolved as a result of this work, vastly improved house paints have been developed. The manufacturers of these improved house paints have been able to tackle the development problem with far more assurance than would have been the case ten years ago when weather testing was conducted along primitive and unscientific lines. The general public has been the ultimate beneficiary of all this work.

Alkyd Resins:

The early day alkyd resins used by the paint industry were sold on claims and not on composition. There was no recognized way to specify or define these resins. Gradually testing methods were developed and the amount of phthalic anhydride became one of the measures of resin quality. This test was standardized by Subcommittee XI and is known as A.S.T.M. D 563. As soon as this and other tests won acceptance, the paint manufacturer was able to visualize the proper outlets for alkyd resin and paint formulation with alkyds progressed rapidly.

With better specifications and testing methods, better alkyds were developed. There has also been a trend toward the evolution of custom-built alkyds to fit specific end uses. While the paint manufacturer has derived the most help from this situation, the public has been the ultimate winner in the form of vastly improved paint products resulting from the use of better alkyd resins.

Driers:

The field of paint drier technology remained more or less stationary for about forty years after the appearance of the first "soluble" driers in 1885. These early day driers lacked purity, uniformity and solubility. Because paint manufacturers little understood the theory of drying, driers were frequently misused or used to excess. Packaged paints frequently developed sludging, bad skinning, or other evidences of faulty driers or faulty drier use.

Sometime about 1925, naphthenic acid driers became available. These driers were stable and more truly soluble than any previously available driers. About 1938 or 1939, the need for drier specifications became evident and after considerable cooperative work, A.S.T.M. Specification D 564 was developed and has since become standard for the drier and paint industry.

With the development of precise testing methods, continued advances have been made in drier technology. Other acids, such as octoic acid, have been used in addition to naphthenic acid. New metals have been discovered with unusual drying properties. Studies have been made to establish the optimum amount of drier in paint. With a better knowledge of driers themselves, the general theory of the drying of vegetable oils has been advanced.

In this particular example, it is difficult to say whether testing methods led to research or research led to testing methods. It is my opinion that the two went hand in hand. Neither would have been possible without the other.

Solvents:

The test methods for lacquer solvents had led to the development of standard types of solvents. This has simplified the purchase and use of solvents and has enabled research workers in the lacquer and solvent fields to speak a common language. Improved solvents have been a direct result of standard test methods.

Note from the Editor.—On a later page, 28, is an announcement of the availability of permanent gloss standards from the National Bureau of Standards. This is yet another example of where the use of an accepted standard, in this case for the measurement of gloss, has had important results on numerous phases of the paint and varnish field.

In commenting on permanent gloss standards, Mr. Lutz noted that some ten years ago reliance had to be placed entirely on visual comparisons, and of course these would be subject to the human error factor. Then glossmeters came into the picture but as lamps were replaced and instruments became worn the need of specific gloss standards was urgent. Meanwhile glossmeters have been improved greatly, and now as a result of the standardization program at the Bureau of Standards permanent reference materials are available which Mr. Lutz points out should be very useful to all companies and persons who have occasion to measure gloss.

Over 600 New Members in 1949

Expanded Work in Standardization and Research Enhances Value of Membership

IT CAN definitely be stated, even though the year has not closed, that upwards of 640 new members joined A.S.T.M. in 1949. While this figure is less than the 1946 and 1947 totals (the peak years) the Committee on Membership is gratified that such an excellent number of individuals and companies feel the A.S.T.M. work is of such value that they wish to keep in close touch with it. 1949 will be the third highest year.

Unquestionably the decreased industrial activity has had repercussions on the Society's membership growth and it is not a wild conjecture that, had there not been a mild recession, the current year might have shown the largest numbers of new members.

The unflagging support given to the acquisition of new members by individuals, committees, and the Headquarters Staff has been an important factor in keeping the membership growth healthy during 1949 in spite of unfavorable business conditions during part of the year.

Some additional statistics on membership will be given in an ensuing BULLETIN. It is of interest to note that the proportion of new company members to individuals has shown quite a decrease over previous years but it is hoped that this ratio will again assume a normal trend in 1950. Those responsible for the financial operations must count heavily on the higher dues which the Society receives from company and sustaining members, and it is encouraging that such a high percentage of organizations which have been A.S.T.M. members for years continue their support.

Value of Membership:

What makes an A.S.T.M. membership of particular value to an individual or company obviously varies greatly in specific cases. One industry may find that its relations between the producer and consumer as they concern quality and testing are based almost entirely on A.S.T.M. standards. This is true in many instances. Another organization may find that the standards are of great value, but the continued outpouring of data on the properties and tests of materials through the extensive A.S.T.M. publications is an equally valuable asset. The individual member, particularly if he serves on technical committees, may feel that his contacts alone justify his affiliations. From the standpoint of publications received, unquestionably the companies as well as the individual members do get for their dues a large number of valuable publications. The policy of the Society's officers down through the years, and continuing, is to furnish A.S.T.M. books to members on a very liberal basis. No charges are made for preprints of papers; the *Proceedings*, Year Book, BULLETIN, Index to Standards, and one Part of the big Book of Standards go to every member, and on every publication that is for sale special reduced prices apply for members.

The organization of new technical committees should be mentioned in any discussion of membership value, no matter how brief. As discussed in various news articles, several new committees have been set up and others are in process. From each of these groups there will be new authoritative information and data, new standardized test methods, and eventually specifications.

The Society's curve of activity is constantly on the uptrend; the number of worth-while and serviceable publications which we are called upon to publish continues undiminished; and one of the results of these and the other A.S.T.M. activities in an increasing membership. The Committee on Membership hopes that each member of A.S.T.M. will, whenever feasible, point out some of the advantages of membership to both individuals and companies who might be interested, and stress at the same time that new members can contribute to the Society's work.

L. J. TROSTEL
Chairman, Membership

CARTER STANARD COLE

1896–1949

THE Society has lost a valued member and we of the Headquarters Staff are greatly saddened in the death on November 17 of our esteemed coworker, Carter Stanard Cole, assistant technical secretary of the Society. While he had not been entirely well for upwards of a year, his death nevertheless has come as a terrible shock to all his friends. He suffered a severe heart attack on November 7 and was taken to Jeanes Hospital in Philadelphia. For a while we were hopeful of recovery, but in a week complications developed and he passed away suddenly after a second attack.

Mr. Cole was born in Culpeper, Va. At an early age he came to Elkins Park, adjacent to Philadelphia, where his father was rector for many years of St. Paul's Episcopal Church. After studying at preparatory schools in Philadelphia and Alexandria, he entered the University of Virginia, graduating in 1917 with the degree of Bachelor of Arts. He served in the Navy during the First World War, and then went with the Pennsylvania Railroad in the motive power division, where he became general foreman of engines with headquarters at Harrisburg. In 1928, he took a position as engineering assistant with the Copper and Brass Research Association in New York and later became their engineer. Early in 1942, he went with the War Production Board in Washington, becoming chief of the Metals Branch of the Conservation Division where he contributed in many ways to the conservation of critical metals and the development of war emergency specifications. In October, 1944, he accepted a position with our staff, later being appointed assistant technical secretary, in which capacity he did much to advance the Society's research and standardization activities, notably in the fields of ferrous and non-ferrous metals and alloys and in corrosion research, fatigue testing, and industrial water His. familiarity with our work generally (he was a member since 1935 and had contacts with A.S.T.M. before then), his years of experience in the railroad field and in the copper and brass industry, and his experience with government specifications during the recent World War, gave him a background for his work on our staff that was of exceptional value. He had carried for several years important administrative responsibilities, among them the chairmanship of the Coordinating Committee on Non-Ferrous Metals and Alloys and the secretaryships of the Advisory Committee on Corrosion, the Administrative Committee on Simulated Service Testing, and the A.S.T.M. Ordnance Advisory Committee, and he did much of the staff work for the Administrative Committee on Research. He handled many special assignments such as staff liaison with the Federal Specifications Board and certain technical societies, reviews of regulations governing standardization procedures and committee work, review and at times editing of reports and papers in his field, and technical correspondence.

All of our officers and members with whom Cole was associated in our activities know how earnestly he devoted himself to his work and how well he carried out his responsibilities and obligations. More than once he had remarked how much he loved his work and this was reflected in all that he did. He was well liked by all who knew and worked with him, and we have received from our members many expressions of their appreciation of his services. Here in the staff Cole had won both our respect for his attainments and accomplishments as well as our deep affection for the man himself. His passing leaves us with a deep sense of grief and loss, and the knowledge that his

place in our ranks will be a difficult one to fill.

He was a member, in addition to A.S.T.M., of The American Society of Mechanical Engineers, the Society of Automotive Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Foundrymen's Society for Metals; also of the Engineers Club of Philadelphia.

In 1926 he was married to Dorothy W. Stevens, who with their two children, Anna Stevens and Carter Lee, and a sister, Anne Lee Cole, survive.

The funeral services were held on November 19 at the Church of our Saviour in Jenkintown, where he worshipped, and he was laid to rest in St. Paul's churchyard in Elkins Park close to the rectory where he grew up as a boy.

C. L. W.

District Activities

SEVERAL interesting meetings have been held under the sponsorship of the various A.S.T.M. districts and a number are planned for the near future or early 1950. Notes on some of these district sessions appear below.

New England—Solar Heating

Two speakers features the technical session on Solar Heating sponsored by the New England District at the Northeastern University Commons, Boston, Monday, October 24. The speakers, both professors at Massachusetts Institute of Technology, have had a very active part in solar heating of houses. L. B. Anderson is in charge of the Department of Architecture at M.I.T., and A. G. H. Dietz, very active in A.S.T.M. work, is in the Department of Building Engineering.

Résumé

In their talks the two speakers first reviewed the general concept of solar radiation and the geometry of the sun's path with respect to the earth at various seasons of the year. The general problems of house-heating requirements and the sources of heat such as mechanical heat and the heat given off by the occupants of the house were discussed. Following this came a more detailed discussion of several experimental installations utilizing solar heat for the heating of houses.

The three M.I.T. experiments which have been carried out since the establishment of the Cabot Fund at M.I.T. for the study of mechanical conversion of solar energy were reviewed. The original M.I.T. house was self-supporting the year round and from which basic information was drawn respecting the performance of flat plate solar energy collectors. The second M.I.T. house made a study of the possibility of combined south wall heat collectors, storers, and radiators. The efficiencies of fusible salts and water storage media were studied in this installation. The third house consists of a small dwelling unit occupied by a student family. In it, approximately 90 per cent of the total heat requirement is met by the sun. The balance is supplied by a small auxiliary heating source. Several other solar heating installations were briefly touched upon. These include the house at Dover, Mass., in which fusible salts are used for the heat storage medium, the overlapping glass plate system under study at the University of Colorado, and the study of large south-facing glass windows undertaken at Purdue University.

This was the first dinner meeting sponsored by the district in Boston, with about 65 present at dinner and upwards of 100 at the ensuing technical session. R. E. Hess, A.S.T.M. Technical Secretary, spoke at the dinner. At the other successful meetings, there has usually been an informal dinner of officers and speakers followed by a separate technical session.

District Program Chairman, E. A. Gramstorff, Northeastern University, arranged the session with the district officers, M. N. Clair, The Thompson & Lichtner Co., Inc., Brookline, Mass., *Chairman*, and C. G. Lutts, Boston Naval Shipyard, Boston, *Secretary*, cooperating closely.

Detroit—Applying Man-Made Isotopes

An attendance of almost 500 greeted the speakers at the evening session of the Detroit meeting on October 27 at the Rackham Building. This meeting featured four papers on the application of man-made isotopes, with a dinner intervening. The program and speakers were listed in the October BULLETIN. The speakers at dinner were the Society's President, J. G. Morrow, and W. L. Cisler, Executive Vice-President, Detroit Edison Co.

President Morrow extended greetings to the members and their friends and visitors present at the dinner. He referred to the topic for the symposium and subjects for other meetings, indicating that the A.S.T.M. interests were very broad. He mentioned the very successful West Coast meeting and that the attendance of some 700 there indicated the widespread interest in the Society's activities.

Mr. Cisler related some of his experiences in his activities during the war which included assistance in the mobilizing of electric power for the preparedness program as part of the function of the War Production Board, office of War Utilities, in the Mediterranean and European Theatre of operations to survey and make recommendations regarding the rehabilitation and operation of electric power facilities, and presently as consultant to the Army and State Departments on electric power in occupied areas, to the Atomic Energy Commission, to the National Security Resources Board and to the Economic Cooperative Administration.

There were about 220 at dinner which had been arranged by A. J. Herzig, Climax Molybdenum Co. District Chairman F. P. Zimmerli presided at both the technical sessions, and in the absence of C. H. Fellows due to illness, who was to be dinner toastmaster, Mr. Zimmerli handled this function also.

Further information will be given concerning the technical papers presented in the sessions.

St. Louis—Major Sources of Energy

At the joint meeting in St. Louis sponsored by the A.S.T.M. District and the St. Louis Engineers Club together with the local chapter of the American Society of Metals, Eugene Ayres, Gulf Research & Development Co., gave his extremely interesting discussion on Major Sources of Energy. The meeting was held at the Engineers Club, and prior to the session, the District Council, their invited guests and the speaker, had dinner.

Mr. Ayres spoke briefly of the continuous sources of energy, such as solar energy, waterfalls, earth's heat, vegetation, tropic waters, tides, atmospheric electricity, wind, and the heat pump. Solar energy and the heat pump may have a future in space heating, that is, for homes and buildings. Tropic waters, tides, atmospheric electricity, and wind will, in his opinion, never play a major role as a source of energy.

On the "unrenewable sources" of energy, which are primarily oil, oil shales, and the various grades of coal, Mr. Ayres presented figures to show that the estimated reserves may be completely erroneous.

Statements on these unrenewable sources of energy that were of interest:

1. The coking coals of Pennsylvania and the Virginias are on the decline and

will present a problem to industry before too many years.

2. Various persons in the oil industry figure that the peak in known oil reserves and productive fields will be reached around 1960. From then on we shall gradually decline in producing oil. Mr. Ayres' own prediction for the peak year is 1957.

3. That if all the oil shale was to be extracted from the state of Colorado, the remaining ash would be enough to form a layer 10 ft. thick over the entire state.

4. Coal seems to be our most plentiful source of energy for the future.

Following the address was a question and answer period with some interesting reasons and responses.

This meeting was arranged by the St. Louis District officers, Dr. J. C. Hostetter, Mississippi Glass Co., Chairman, and J. M. Wendling, City of St. Louis, Secretary.

Western New York-Ontario—Smoker and President's Reception

With the Society's President, J. G. Morrow, Steel Company of Canada, a member of its district, the Western New York-Ontario group arranged a smoker and informal reception for him in Buffalo on November 7. This was limited to A.S.T.M. members, and while the attendance was somewhat smaller than the officers had hoped for, there were a goodly number there, and there was excellent opportunity for the President and Executive-Secretary, C. L. Warwick, who came up from Philadelphia, to meet all those present. There were refreshments and music, and the officers advise everyone had a good time.

The Committee on Arrangements which planned and carried through the meeting consisted of past district chairman T. L. Mayer, Buffalo Public Library, with W. H. Lutz, Pratt & Lambert, Inc., past chairman of the Administrative Committee on District Activities, and Joseph Gentile, Pittsburgh Testing Laboratory, District Secretary. The officers had a 100 per cent attendance, with O. W. Ellis, Ontario Research Foundation, Chairman, and the two vice-chairmen, Messrs. L. F. Hoyt, National Aniline Div., Allied Chemical and Dye Corp., and L. V. Foster, Bausch & Lomb Optical Co., also present.

Philadelphia—Stress Analysis in Action

A joint meeting of the Philadelphia District and the local section of the Society for Experimental Stress Analysis will be held on January 31, 1950, in the Benjamin Franklin Hotel Ball Room, dinner beginning at 6:30, and the Technical Session, at 8 o'clock, with W. T. Bean, Jr., Research Consultant, Detroit, giving his interesting lecture, "Stress Analysis in Action." This meeting will be held during the three-day series of meetings in Philadelphia of Committee A-1 on Steel.

New developments in testing equipment will be demonstrated, and various equipment, some of it shown for the first time, will be presented in actual operation. Wire strain gages, microformers, oscilloscopes and cameras, strain indicators, accelerometers, etc., will be demonstrated.

Mr. Bean, a combination of genial personality and keen understanding of engineering problems, is devoting a large part of his time just now to making stress analysis and design studies alive and exciting. His background includes six years at Continental Aviation and Engineering Corp. where he was in charge of the stress analysis laboratory and Project Engineer on the development of the air-cooled engines for the Army Ordnance. At present, he is a Research Consultant.

Local groups are urging all those who can, to attend dinner. Dinner reservations can be made with E. J. Albert, Dinner Chairman, sending reservations to him, c/o A.S.T.M. Headquarters. Frank G. Tatnall is the evening's Program Chairman.

Future Meetings

Two meetings in the immediate future will be of interest in the respective districts. In Pittsburgh on November 29, Dr. Alexander Silverman, Head of the Department of Chemistry, University of Pittsburgh, is speaking on the Quality and Utility in Modern Glass, this meeting being held at Mellon Institute with everyone invited. The ladies also were advised that they would find the program of interest. Details of the meeting in the next BULLETIN.

Research for Management

In Philadelphia, on December 14, there is a two-session meeting with six speakers, and at the dinner, Vice-Admiral Howard G. Bowen, U.S.N., retired, will be the speaker. This meeting is arranged jointly with the Franklin Institute, and the sponsors are making a real effort to contact management in the area and invite them to the meeting. All members and others interested are cordially invited but dinner reservations are recommended, because the capacity of the Lecture Hall is limited. A copy of the detailed program will be mailed promptly on request. The January BULLETIN will carry further details of this meeting.

Joint ASTM-ASQC Meeting

THE Philadelphia District of A.S.T.M. and the Philadelphia Section of the American Society for Quality Control presented a joint meeting on October 12, at which time Mr. Robert Burns, Bell Telephone Laboratories, presented his interesting talk on "Quality Control in Materials Procurement" before an attentive audience of more than 125 members and visitors.

The meeting was at the Franklin Institute.

Mr. Burns, a self-styled "dyed-in-the-wool A.S.T.M.er," illustrated the need for quality control in industry by several methods, including the experience of a friend of his who recently purchased a new car. The new car contained a clock which would not run at all. This was replaced by a second which ran for several days and then stopped. A third clock was installed and was, the last he knew, running, but running slowly.

One of the difficulties showing the need for quality control or the enforcement of quality control in an organization of any size is that the sales department is too remote from the quality control group. An example of the ideal quality control is that of a woman buying bread from a grocer. She has her own specifications as to texture, freshness, size, etc., and it is up to the grocer to meet her specifications if he wishes to sell any bread to her.

In the field of mass production, it should not be the desire of the quality control group or of the consumer that each and every item should be essentially perfect. Specifications should be written with a clause stating that acceptability should be based on some percentage being perfect, such as 95 or 98 per cent, depending on an agreement between the manufacturer and the purchaser.

Several other points advanced by Mr. Burns for the failure of quality control groups were (*a*) the gap between establishment of specifications and their enforcement, (*b*) the fact that the majority of tests are largely destructive, and (*c*) the length of time it takes to make many tests.

Synopsis of Professor Anderson's Talk on Solar Energy

Given at the New England District Meeting, Oct. 24

THE earth's surface temperature is fairly constant due to rapid rotation, storage characteristics, and blanketing effect of atmosphere. This temperature is close to optimum human environment, but needs some further tempering. Various methods are: clothing, caves, migration, fire, dwellings. Even without fire, dwellings are warmer and more uniform than outdoors. Food, the source of metabolic heat and combustion fuel for house heat, come from solar energy. We maintain conditions of comfort through controlling the flow of solar energy in time and place.

The axis of daily rotation of the earth is inclined 24 deg. from normal to the plane of the ecliptic, so that earth rotating about the sun causes the seasons. In winter the duration of sunshine is less, and also there is less energy per acre while it is shining because of the lower angle. But a south-facing vertical wall intercepts more energy in winter and less in summer.

Horizontal and vertical incidence trace complementary curves when plotted over the full cycle of a year. Maximum vertical incidence corresponds well with heating season, although there is a pronounced inertia lag in temperature year as compared to the astronomic year. Average Boston temperature in September is 64 F., March only 37 F. For any period of the year there is an optimum plane of collection that will intercept the most energy during that period.

Glass is a good medium for transmitting short-wave solar radiation, deterring re-radiated heat flow outward. A south wall of glass can be shaded so as to minimize heat gain in summer without obstructing winter penetration. Foliage may also be used for shading.

Night losses are, however, great, even with heavy curtains. Over-all consumption in a house with a south-facing glass wall is about the same as with small windows, but the heat load is more variable. A desirable architectural solution is permitted without much thermal penalty.

For more perfect utilization, even in clear weather, the dilemma is to distribute heat in daytime, using at night the excess heat intercepted during the day. Storage alone, as exemplified by a concrete slab floor, will iron out extremes and postpone the peak. A minimum air change—except to correct overheating—and night insulation of the window produce the best condition. If day is too hot, night too cool, considerable storage inertia is needed. If days are hot, nights normal, both sun and air change should be excluded during day, air change employed at night.

In a severe winter climate the south window will not be adequate in itself. In the Cabot Fund house the south window is supplemented by a collection and storage device mounted on the roof. The house is small, has a floor area of roughly 600 sq. ft. It is shaped for maximum length east-west so as to have maximum exposure to noon sun for south wall and for collector. This shape, though extreme, provides a workable room arrangement. The collector area is about 400 sq. ft.; the south wall area about 400 sq. ft.; together they exceed the floor area. Heat loss at night is reduced by folding partition type of curtain. Over-all heat load is designed down so low that the three occupants themselves supply a substantial fraction.

Officers Elected for Ohio Valley District

BY LETTER ballot action of members and committee members in the Ohio Valley District, officers of the district have recently been elected. This ballot was sent out under the direction of the Administrative Committee on District Activities, headed by Frank G. Steinebach, Penton Publishing Co., Cleveland. The new district is to be headed by J. C. Harris, Monsanto Chemical Co., Dayton, *Chairman;* with J. H. Calbeck, American Zinc Sales Co., Columbus, *Vice-Chairman,* and J. C. Pitzer, The Formica Insulation Co., Cincinnati, *Secretary.*

The complete personnel of the District Council appears below.

Over a year ago, the Council *Pro-Tem,* headed by J. W. Bolton, The Lunkenheimer Co., Cincinnati, a long time member of A.S.T.M., the council having been appointed by the A.S.T.M. Board of Directors, arranged for a district meeting during sessions in Dayton of Technical Committees D-9 and D-20. Subsequently a Nominating Committee was appointed and the election conducted in accordance with the regulations in the Charter for A.S.T.M. Districts.

The Administrative Committee on District Activities, which is an arm of the Board of Directors, has wished for some time to organize a district in the area encompassing Louisville, Indianapolis, Cincinnati, Dayton, and Columbus, the area being shown in a map in the A.S.T.M. Year Book, page 178. This section has about 300 members and committee members.

Many of the members of the new council are active in A.S.T.M. affairs, and their names are well known to members not only in the district, but nationally. Mr. Harris has been active in Society affairs for a number of years and has been particularly concerned with the work of Committee D-12 on Soaps and Other Detergents, of which he is Secretary. Just recently as a result of his intensive work, the Society has issued a greatly revised and expanded bibliography and book of abstracts on metal cleaning. Mr. Calbeck is concerned with the work of Committee D-1 on Paint, Varnish, Lacquer, and Related Products, where he serves on many subcommittees, and also the Committee on Appearance, E-12. Mr. Pitzer has been an active worker in Committee D-9 on Electrical Insulating Materials, Committee D-20 on Plastics, where he represents not only his own company, but the National Electrical Manufacturers' Association, and he was a prime mover on the Committee on Arrangements for the one national meeting the Society has held in this immediate area in 1944 when the Spring Meeting and Committee Week took place in Cincinnati.

As the Council develops its plans and program of activities, announcements will be made directly to all members in the district, and through the ASTM BULLETIN all members of the Society will be kept advised.

OHIO VALLEY DISTRICT COUNCIL

J. C. Harris, *Chairman,* Research Group Leader, Monsanto Chemical Co., Nicholas Road, Dayton 7, Ohio.

J. H. Calbeck, *Vice-Chairman,* Director of Research, American Zinc Sales Co., Box 327, Columbus 16, Ohio.

J. C. Pitzer, *Secretary,* Chemical Engineer, The Formica Insulation Co., 4614 Spring Grove Ave., Cincinnati 32, Ohio.

Councilors

J. W. Bolton, Director of Metallurgical Research & Testing, The Lunkenheimer Co., Cincinnati, Ohio.

R. R. Bowser; Director, Bowser-Morner Testing Laboratories, Dayton, Ohio.

E. W. Campion, Chairman, The Bonney-Floyd Co., Columbus, Ohio.

F. M. Crapo, President, Indiana Steel and Wire Co., Muncie, Ind.

H. B. Currens, Chemical Engineer, Lilly Varnish Co., Indianapolis, Ind.

E. W. Fasig (*Ex-Officio*), General Superintendent, The Lowe Brothers Co., Dayton, Ohio.

A. C. Goetz, Manager, Technical Service Dept., The Eagle-Picher Co., Cincinnati, Ohio.

N. J. Greene, Chief Engineer, National Electric Coil Co., Columbus, Ohio.

T. W. Guy, Consulting Engineer, Coal Preparation, Charleston, W. Va.

William Heilig, Vice-President, In Charge Engineering and Development, The William Powell Co., Cincinnati, Ohio.

Archibald Hurtgen, Chief Metallurgist, Henry Vogt Machine Co., Louisville, Ky.

C. F. Lauenstein, Chief Metallurgist, Link-Belt Co., Indianapolis, Ind.

C. E. MacQuigg, Dean, College of Engineering, Ohio State University, Columbus, Ohio.

P. E. Marling, Monsanto Chemical Co., Dayton, Ohio.

H. K. Nason (*Ex-Officio*), Acting Director, Central Research Dept., Monsanto Chemical Co., Dayton, Ohio.
H. C. Nutting, President, H. C. Nutting Co., Cincinnati, Ohio.
T. F. Olt, Director, Research Labs., Armco Steel Corp., Middletown, Ohio.
H. C. Schwalbe, Chemical Engineer, Mead Corp., Chillicothe, Ohio.
F. C. Smith, Chief Metallurgist, Tube Turns, Inc., Louisville, Ky.
W. B. Wendt, Professor of Civil Engineering, University of Louisville, Louisville, Ky.

New York—Isotopes in Industry—Future of Nuclear Power:

Under the joint auspices of the A.S.T.M. New York District, and the Metropolitan Section of the A.S.M.E., an excellent meeting was held on Friday October 28, in the Engineering Society's Building. Dr. John R. Dunning, Professor of Physics, Columbia University, and Albert L. Baker, Vice-President, Kellex Corp., were the chief speakers.

Mr. Baker's subject, "The Future of Nuclear Power," discussed some of the engineering aspects of the generation of power by nuclear fission. He showed charts which gave the component parts of such a plant as presently conceived as well as the flow of the fuel and the flow of the power-generating media. A nuclear power plant was compared with a conventional power plant and the unique features of a nuclear plant such as the fuel reprocessing systems were described. By simple demonstrations, Mr. Baker showed the practicability of the proposed scheme. One of his experiments, for example, indicated the ease of fuel reprocessing.

Dr. Dunning discussed and demonstrated some of the applications of "Isotopes in Industry," such as the use of the absorption of radiation by materials to measure their thickness; the measurement of wear by transfer of radioactive material from one surface to the other; the use of a tracer-element on a float inside a closed tank to indicate liquid levels; the increase in sensitivity of a chemical balance through the use of a radioactive deposit on the beam to detect its slightest motion; and the detection of incipient corrosion by tracers using photographic emulsions.

There were upwards of 300 in attendance at the meeting. The Technical Chairman was V. Weaver Smith, The Lummus Company, representing the A.S.M.E., and the Program Chairman was E. P. Pitman, The Port of New York Authority, representing the A.S.T.M. Officers of the A.S.T.M. District Council, Myron Park Davis, Chairman, E. A. Snyder, Vice-Chairman, and G. O. Hiers Secretary, cooperated closely on meeting arrangements.

"Statistical Design of Engineering Tests" —Topic at ASTM—Statistical Association Joint Session

THE Statistical Design of Engineering Tests will be the general topic of two technical papers to be presented at a luncheon and technical session sponsored jointly by A.S.T.M. and the American Statistical Association during the latter's annual meeting in New York City. This luncheon is to be at the Biltmore Hotel on Wednesday, December 28. The Society's Executive Secretary, C. L. Warwick, will preside at this joint affair.

The technical papers are to be presented by two outstanding men in their field: Grant Wernimont, Eastman Kodak Co., will cover "Design and Interpretation of Interlaboratory Test Programs," and W. J. Youden, National Bureau of Standards, will discuss "Comparative Tests in a Single Laboratory." There will be discussion following the papers, with W. G. Cochran, The Johns Hopkins University, and P. S. Olmstead, Bell Telephone Laboratories, participating.

Luncheon reservations at $4 each should be sent to

FRANK A. DE HERMIDA, Chairman
Committee on Arrangements
American Statistical Association Convention
Care of West Indies Sugar Corp.
60 East 42nd St.
New York 17, N. Y.

The luncheon is scheduled to get under way at 12:30 o'clock, ending at 3:30.

1950 Annual Meeting in Atlantic City

Apparatus and Photographic Exhibits to be Held

AN INTERESTING technical program is being developed for the Society's 1950 (53rd) Annual Meeting to be held at Chalfonte-Haddon Hall in Atlantic City. Several of the Atlantic City hotels will cooperate in connection with sleeping room requirements.

The dates are June 26 to 30, inclusive.

Throughout the week there will be in progress the Society's Ninth Exhibit of Testing Apparatus and Related Equipment in which leading manufacturers and distributors of scientific instruments and laboratory supplies will display new products and the improved instruments that are available and so widely used in evaluating materials and products. Many of the leading companies in the industry have already reserved space and an interesting exhibit is assured. It is expected there will be a number of scientific and educational displays as well.

Photographic Exhibit:

Another feature of the meeting will be the Seventh Photographic Exhibit and Competition, this year being sponsored by the Philadelphia District which is the host for the meeting. The exact theme for the photographic display is being selected by a special committee. Early next year there will be transmitted to each A.S.T.M. member an entry blank and a statement of rules and regulations. Meanwhile, members are urged to earmark prints which will be appropriate for display. In general, the exhibit theme will involve "materials and testing."

Committee Appointed on Award of Merit

ACTING in accordance with the rules governing the A.S.T.M. Award of Merit, President J. G. Morrow has appointed an Award of Merit Committee which is to consist of five members. The personnel of this committee, the first to be appointed, is as follows:

T. A. BOYD, *Chairman*, General Motors Research Laboratories, Detroit, Mich.
D. E. PARSONS, National Bureau of Standards, Washington, D. C.
C. H. ROSE, National Lead Co., Brooklyn, N. Y.
H. S. VASSAR, Bloomfield, N. J.
L. H. WINKLER, Bethlehem Steel Co., Bethlehem, Pa.

As announced in the July, 1949, BULLETIN, p. 30, the purpose of this Award is to recognize individuals who have rendered distinguished service to the Society. The rules governing the Award recognize several different categories of distinguished service, cover the number of Awards which are limited to not exceed one per 750 members or fraction, and the method of selection is described. On recommendation from the Award of Merit Committee, the Awards are granted by the Board of Directors. The A.S.T.M. technical committees have an important responsibility in this new Award since they have the privilege of making annually, with an appropriate citation, one nomination. Other nominees may be selected by the Award Committee. *Nominations are to be in the hands of the Executive Secretary not later than February 1.* For details see July BULLETIN, or write to Headquarters.

TECHNICAL COMMITTEE NOTES

Organization of New Committee on Chemical Resistant Mortars

FOLLOWING approval by the Board of Directors of the formation of a new committee on chemical resistant mortars, a tentative organization was set up at A.S.T.M. Headquarters on October 19 under the temporary chairmanship of Dr. F. O. Anderegg of the John B. Pierce Foundation. B. Thomas, Stebbins Engineering and Manufacturing Co., was appointed Temporary Secretary and C. R. Payne, Electrochemical Supply and Engineering Co., Temporary Vice-Chairman. This activity is now separated from Committee C-12 on Mortars for Unit Masonry where a subcommittee has been active in this field.

The proposed scope of the newly formed committee states, "The stimulation of research and the formulation of specifications, methods of testing, and definitions relating to chemical resistant mortars."

The following subcommittees were proposed:

I. Advisory
II. Silicate Mortars
III. Resin Mortars
IV. Sulfur Mortars
V. Hydraulic Cements
VI. Miscellaneous Mortars including litharge-glycerine, certain Sauereisen cements, etc.
VII. Working Time
VIII. Bond Strength

A temporary subcommittee on By-laws was also set up.

Subcommittee III on Resin Mortars indicated that their primary consideration would include use, specifications, mixing techniques, and shelf life. Subcommittee IV on Sulfur Mortars will consider specifications, tensile strength, compressive strength, moisture absorption, flexure test, and others.

Those interested in the work of this committee are invited to contact any of the present officers or A.S.T.M. Headquarters. The next meeting is planned to be held in Atlantic City at the time of the 1950 Annual Meeting of the Society in June.

Revised Specifications for Deformed Concrete Reinforcement Bars Available

IN 1947, the Society first published Tentative Specifications for Minimum Requirements for the Deformation of Deformed Steel Bars for Concrete Reinforcement (A 305). This specification, under the jurisdiction of Committee A-1 on Steel, filled the need for a document giving standard requirements for the dimensions of deformed steel bars for concrete reinforcement. There has been research work under way for some time to determine whether the requirements as published were satisfactory. The results of this research were made known in the spring of this year.

At the Annual Meeting in June, Committee A-1 on Steel requested special action by the Society in advancing the tentative to the status of a standard with revision. The revision included changing the maximum spacing requirements for deformations to be 0.7 of the nominal size of the bar, this revision having been endorsed by representatives of the American Concrete Institute, American Association of State Highway Officials, and others.

The Society approved the recommendation, subject to a favorable vote in Committee A-1. Subsequent to the Annual Meeting, a letter ballot vote of Committee A-1 resulted in approval of the recommendation.

The Society is printing 10,000 copies of the revised specifications, having already on order over 9000 copies. Separate copies are expected to be available by the early part of December. Orders can be transmitted to Headquarters.

Committee D-14 on Adhesives

THE meeting of Committee D-14 on Adhesives, held on October 17 and 18, was one of the best-attended meetings ever held at the A.S.T.M. Headquarters in Philadelphia. More than 65 members and visitors attended the two-day session.

Subcommittee I on Strength Properties discussed the need for a method of determining tensile strength of low-strength adhesives and will attempt to develop such a method. This subcommittee plans round-robin tests to determine the shear and related properties of an adhesive used for bonding plastic to plastic specimens.

Subcommittee II on Analytical Tests has established a Section on Creep under the chairmanship of A. J. Kearfoot.

Subcommittee V on Specifications set up six new sections for various types of adhesives. Most of these sections were organized as a result of numerous requests from large-tonnage manufacturers or consumers. The six sections are: Office Adhesives, Acoustical-Tile Adhesives, Book-Binding Adhesives, Packaging Adhesives, Labeling Adhesives, and Brake-shoe-Bonding Adhesives. The committee decided to take the material that is now used as an introduction to each test method and submit it as a recommended practice.

One of the highlights of the main meeting was the talk by Robert P. Hopkins, Resinous Products Division, Rohm & Haas Co., on "Evaluation of Test Procedure for Resin-Bonded Wood." The essence of Mr. Hopkins' paper was that the present test methods for determining the strength properties of wood bonded to wood are inadequate for performance testing. He stressed the point that one of the most important things to be studied would be that of construction of the test specimen and that proper or improper construction of the specimen can have as much effect upon the results as the adhesive itself.

Textile Committee Activities

COMMITTEE D-13 on Textile Materials held its fall meeting at the Benjamin Franklin Hotel, in Philadelphia, Pa., on October 19 through 21. During the three-day session, meetings were held of some 20 subcommittees and task groups. The interest in the activities of this committee was evidenced by the attendance of 225 members and guests.

One of the features was a technical session on Thursday afternoon at which three papers on Modern Techniques in Microscopy and Their Application in Textile Research were presented:

A New Technique for Making Very Thin Clear Sections and Its Application in Electron Microscopy, S. B. Newman, National Bureau of Standards.

Some Applications of Modern Microscopy to the Study of Fibers and Thin Films, F. F. Morehead, American Viscose Corp.

Some Applications of Modern Microscopy to the Study of Chemical Phenomena and in the Dyeing and Printing of Textiles, G. L. Royer, American Cyanamid Co.

At a luncheon the committee paid tribute to two of its members, A. G. Ashcroft and Werner von Bergen, for the services they had rendered the committee during the past 15 years in directing work on wool and wool products, and for their individual contributions in this field.

In the subcommittee on cotton and its products, Section 1 is organizing a fineness task group under the chairmanship of Dr. Ruby Worner. A task group on interlaboratory check testing will also probably be organized after the chairman has checked the membership of the section to determine those interested in participating in interlaboratory check tests. Only those tests that have been widely accepted will be included in the check testing.

The section on cotton yarns and threads considered further revisions in the methods of testing and tolerances for cotton yarns (D 180 – 49 T). H. L. Pratt was appointed to represent this section on the exploratory committee being organized by Mr. Appel to investigate a general method for testing all yarns.

The subcommittee on bast and leaf fibers and their products received an extensive report on round-robin tests of twine from nine cooperating laboratories. The test data covered breaking strength, yardage (linear density), and twist determinations. After considering a statistical study of the data the subcommittee decided that further cooperative tests should be made. When these are completed the committee expects to be able to recommend a sampling method and procedures for breaking strength and yardage.

The subcommittee on pile floor coverings decided to make further studies of the apparatus and type of fuel used in its flame test for pile floor coverings. It is hoped that a test for fire resistance may be submitted as tentative.

A tentative method of test for resistance of pile floor coverings to insect pest damage was approved for submission to letter ballot of the subcommittee.

A task group has under development a method for determining the resistance to fraying of lockweave type carpets. Another task group is exploring the possibility of establishing photometric methods using light-fastness standards.

The subcommittee on nomenclature and definitions is giving further consideration to the definitions of the terms "rayon" and "estron." An article by the chairman of the definitions subcommittee, A. G. Scroggie, on "Universal Yarn Numbering Systems" appeared in the May issue of the *Textile Research Journal*. This article, which sets forth the American position on the question of yarn numbering, has been reprinted by A.S.T.M. and widely distributed to interested organizations both in this country and abroad. Copies may be obtained without charge on request to Society Headquarters.

The subcommittee on test methods has an active program under way. At its meeting reports were received from task groups on water permeability tests, durability of elastic fabrics, evenness of yarn, hand of fabrics, determination of copper and manganese in textiles, crease resistance, fraying, identification of textile finishes, analysis of nylon mixtures, antiseptic finishes, fluidity tests, colorfastness to light, abrasion testing, and fire resistance tests. Two papers were presented on "Present Approach to Problems Relating to the Fire Resistance and Flammability of Textiles," by G. F. Buck and "The Development and Methods for the Evaluation of Resistance of Treated Textiles to Insect Pests," by H. E. Wilde.

Textile Committee Honors von Bergen and Ashcroft

FOR their long-time and intensive work in behalf of A.S.T.M. Committee D-13 on Textile Materials, in particular the work on wool and wool products, and to the wool industry generally, Messrs. Werner von Bergen and A. G. Ashcroft were honored at a luncheon on October 19 in Philadelphia during the Committee D-13 fall meetings. Scrolls were presented to each of the men. Dr. von Bergen, Director of Research, Forstmann Woolen Co., received his scroll from Dr. S. J. Kennedy, Research Director in the Office of the Quartermaster General in Washington, who praised the recipient particularly for his work as Chairman of the Wool Fibers Section of the Wool Subcommittee. Mr. Ashcroft, Director of Research, Alexander Smith and Sons Carpet Co., and a past member of the A.S.T.M. Board of Directors, received his scroll from Dr. J. H. Dillon, Director of the Textile Research Institute at Princeton, who recognized Mr. Ashcroft's work as Chairman of the Wool Subcommittee and his pioneering in statistical techniques and quality control.

In addition to many of the members and officers of Committee D-13 there were present numerous executives and others concerned with the wool industry. O. P. Beckwith was master of ceremonies at the luncheon.

von Bergen-Ashcroft Award: (left to right) J. S. Kennedy, Werner von Bergen, O. P. Beckwith, A. Griffin Ashcroft, and J. H. Dillon.

Group on Shipping Containers Meets

THE Fall Meeting of Committee D-10 on Shipping Containers held at the Hotel Statler, Detroit, on October 6 and 7, again emphasized the value of performance standards. This is especially true when it is realized that the test methods are in the form of simulated service tests. The committee met in conjunction with the meeting of the Industrial Packaging Engineers of America.

The several subcommittees which met on October 6 made progress reports. The Subcommittee on Definitions is now reviewing a group of terms pertaining to interior packing and expects to develop definitions for such difficult terms as "packing, packaging and package." The present tentative list of definitions (D 1008 T) was recommended for advancement to standard. All existing standards under the jurisdiction of the Subcommittee on Methods of Testing are being scrutinized for further refinement which has been felt necessary in the development of performance standards. In this respect, recommendations were made for the incline impact test specifying that the top cover of the dolly shall be made from group 4 wood or plywood, the backstop to be rigid and full contact established between the container and the dolly. A change in the drop test for bags is recommended which will set up two procedures, one permitting drops on any one part of the bag and a second procedure to be based on a definite cycle of drops. A new section will be formed to develop a pallet test. A final draft of a method of testing large shipping cases and crates is now ready for submittal to letter ballot of the subcommittee.

The Subcommittee on Performance Standards has been divided into seven groups, each group covering the development of performance standards on each of the existing A.S.T.M. test methods. Weight classifications for handling purposes have been agreed upon covering the range of shipping containers based as follows: 0–50 lb. one-man throwing; 51–90 lb., one-man lifting; 91–200 lb., two-man lifting; 201–500 lb., manual with equipment; 501–1000 lb., power equipment; and over 1000 lb., special equipment. Limits are being established covering the various factors of each test method in order that basic data may be secured in developing performance standards. This includes such items as establishing weight groups for the drop test and definite preconditioning limits in the compression tests.

The Subcommittee on Correlation of Tests has inaugurated a program to review data covering the revolving drum test (D 782) in which initial tests were confined to the No. 24 two-can container in the 7-ft. revolving drum. Corner drop and incline impact test will be considered next for the purpose of establishing the variability of each test before correlation is obtained. The Subcommittee on Interior Packing is concentrating on definitions of terms with 36 new terms being reviewed and accepted. A total of 178 terms have been developed to date.

Following the main meeting on October 7, the group participated in an inspection trip of the Cadillac Motor Car plant with special attention being given to the spare parts packaging and shipping departments. It is planned to hold the next meeting of the committee at Madison, Wis., on April 27 and 28, at which time an inspection of the Forest Products Laboratory will be made.

Standard for Stainless Steel Pipe ASA B36.19-1949

A NEW American Standard for Stainless Steel Pipe has just been issued through the work of Sectional Committee B36 on Standardization of Wrought-Steel and Wrought-Iron Pipe and Tubing. This committee functions under the procedure of the American Standards Association, and is sponsored jointly by A.S.M.E. and A.S.T.M. It was apparent with the complexities involved in the production and use of stainless pipe that a separate standard other than ASA B36.10 would be helpful; hence the Sectional Committee assigned a subgroup to develop such a standard. The Foreword to the standard is descriptive of the scope and objectives, and reads as follows:

This standard for corrosion-resistant piping, designated categorically as *Stainless*, is based on the same principles that formed the background for the development of American Standard for Wrought-Steel and Wrought-Iron Pipe (ASA B36.10) and reference is made to this source of information.

The wall thicknesses shown for Schedules 40S and 80S are identical with those of Schedule 40 and 80 in ASA B36.10 except in the 12-in. size in Schedule 40S and the 10- and 12-in. sizes in Schedule 80S. The thickness for these three sizes corresponds to wall thicknesses of standard wall and extra strong wall.

The more recent developments of the highly alloyed stainless steels have brought about a minor conflict with convention. With these newer materials, the need for standards is just as great and the present types of threads are just as satisfactory, but the basic cost of the metal is much higher and the art of fusion-welding has developed concurrently. The character of stainless steel permits the design of thin wall piping systems without fear of early failure due to corrosion, and the use of fusion welding to join such piping has eliminated the necessity of threading it. For these reasons, the wall thickness dimensions shown under Schedule 10S have been developed, based on the conventional formula but then modified to correspond to the nearest Birmingham Wire Gage (B.W.G.) number.

Copies of this Standard on Stainless Steel Pipe can be procured from the American Standards Association, 70 East 45th St., New York 17, N. Y., or from the A.S.M.E., which published the document, 29 West 39th St., New York 18, N. Y., at 30 cents a copy.

Committee C-14 on Glass and Glass Products

COMMITTEE C-14 on Glass and Glass Products met at Shawnee-on-Delaware, Pa., on October 6 in connection with the Autumn Meeting of the Glass Division of the American Ceramic Society. It was voted within the committee that the definition of "wire glass" should be editorially revised to conform to the American Standards Association definition of wire glass. A request for specifications for live load of rectangularly shaped glass used in the manufacture of skylights was presented to the committee and it was decided that this request be submitted to the Subcommittee on Flat Glass. It was indicated that there is a considerable interest in this field at the present time and representatives of the Flat Glass Subcommittee indicated that work in this field will be the basis for part of the future work of the subcommittee.

Temperature and Human Life

"EVERYONE talks about the weather and nobody does anything about it," is a remark often heard. Since climate is directly related to heat and humidity, this book by Drs. Winslow and Herrington of the John B. Pierce Laboratory in New Haven, Conn., should be of interest to many readers, not only to those in scientific fields but to laymen as well. This is particularly true because the subject matter is presented in a clear, concise style understandable to anyone who has had the rudiments of general science.

The first three chapters deal mainly with heat in the body itself, how it is produced, how distributed, how lost from the body, and how the body adapts itself to varying environments. In succeeding chapters, the kinds of clothing suitable for different climates, the best climate, the objectives of air conditioning and the best kind of air conditioning, and various kinds of heating systems for houses in different climates are discussed. Detailed descriptions of experiments on human subjects at the John B. Pierce Laboratory, where the authors conducted their researches, are presented. Charts and photographs serve to illustrate further these descriptions.

Copies of this book can be obtained from the Princeton University Press, Princeton, N. J., at $3.50 per copy.

New Mirror at Headquarters

THE Society is very much indebted to Dr. S. Frank Cox, Director of Research, Pittsburgh Plate Glass Co., for his gift of a large, framed mirror for the Headquarters Building. It was a most thoughtful and generous gift, and the Society wishes to express its sincere thanks to Dr. Cox.

It now hangs on the wall of the Members' Room opposite the portrait of Charles B. Dudley (founder member and first president of the Society). The mirror adds much to the beauty of the room. In the short time that it has been hanging in this room many visitors and members have noticed and admired it.

Gloss Standards

PERMANENT gloss standards, covering the entire gloss range of nonmetallic commercial materials, prepared according to A.S.T.M. D 523 requirements for 60-degree specular gloss, are now available at a cost of $70 from the National Bureau of Standards. They consist of two 4½-in. square white Vitrolite plaques having nominal gloss values 1 and 90, and eight glazed ceramic similar sized plaques with nominal gloss values 10, 20, 30, 40, 50, 60, 70, and 80; these plaques are treated to prevent absorption of water. These standards may be used to calibrate any 60-degree specular glossmeter in the range from matte to high gloss, and the surfaces have been specially chosen for similarity to commercial materials whose gloss is important. With glossmeters commercially available at the present time, replacement of the lamp, for example, may introduce instrumental error unless readjustment is made. The new gloss standards permit a rapid check of instrument calibration at any time and give a basis for readjustment of the instrument if required. It should be noted that measurements in the medium- to high-gloss range necessitate the glossmeter meeting, very closely, the aperture requirements in A.S.T.M. Method D 523.

Measurement of gloss is becoming increasingly important in many industries and this is another instance where the use of an A.S.T.M. standard has led to a development important in research which ultimately culminates in service to the general public. For example, high-gloss paper is required for good reproduction of half-tone prints, and low-gloss paper for easy reading of materials in type. Building interiors must range from semi-gloss to matte to prevent eyestrain caused by reflected images of the light sources. Gloss of a paint finish should always be adjusted to the use of the finish. Outdoor finishes, such as automotive enamels, have high gloss for performance while matte finishes are given most war goods for low visibility. Gloss measurements are also important in defining the wear resistance of plastics and ceramics.

The Thermal Insulation Society Organized

THE Thermal Insulation Society has recently been organized with headquarters in Charleston, W. Va. According to its proposed constitution, it has been created to accumulate, record, and disseminate information to those interested in thermal insulation; to coordinate the study and solution of problems and provide a medium of exchange of ideas between those engaged in the various phases of work with thermal insulation materials; to promote cooperation with other organizations engaged in the technical and physical development, production, and improvement of these materials; to endeavor at all times to advance the science of thermal insulation and increase the knowledge thereof.

Officers elected for the current year are: President, Ray Thomas, Carbide and Carbon Chemicals Corp., South Charleston, 3, W. Va.; Vice-President, L. E. Langfitt, American Viscose Co.; Treasurer, H. B. Hickman, E. I. du Pont; Secretary, James Collins, Johns-Manville Sales Corp.

Subjects discussed thus far at meetings include: Some of the Fundamentals of Thermal Insulation; Heat with Its Control; Boiler Setting, Mathematical Behavior of BTU.'s and Dimensional Standards of Thermal Insulation.

Interested persons are urged to write to the President or Secretary for further information.

Story of Refractories

RECENTLY published by the General Refractories Co., this book entitled "Refractories" provides a handbook of complete, accurate and up-to-date information. It is intended to serve those who design, use, purchase, construct, and supervise the operation of equipment requiring refractory materials.

Beginning with a brief history of refractories from the sun-dried brick of old Egypt to the modern all-basic open-hearth steel furnace, the book takes up every phase of refractory practice. It describes the manufacture of refractory brick from raw material selection to the finished product. It tells what industries use refractories, where and why, and provides a guide to selection of the refractories best suited for each use.

A section of the book has pictures, and gives dimensions of standard refractory brick sizes and shapes. Another deals with the properties and behavior of refractories; this includes mention of many physical tests based on A.S.T.M. methods such as for thermal conductivity, strength and hardness, spalling, and flow deformation under load at high temperature, etc. Perhaps as important as any other section is the glossary which defines, in some cases for the first time in print, the meanings of many terms—including those in A.S.T.M. Method C-71 used in this industry.

For engineers and architects who design and build equipment there is much information on construction with refractories, as well as tables that simplify the calculation of numbers and types of brick needed. For the purchasing agent, there are the trade practices and other information concerning ordering and shipping of refractory materials.

Copies of this 272-page book with a complete index may be obtained at $5 per copy from The General Refractories Co., 1520 Walnut St., Philadelphia 2, Pa.

Iron Blast-Furnace Slag

THE National Slag Association has announced the release of Bulletin 479 by the Bureau of Mines, U. S. Dept. of Interior entitled, "Iron Blast Furnace Slag—Production, Processing, Properties and Uses" by G. W. Josephson, F. Sillers, Jr., and D. G. Runner. This report was prepared in cooperation with the National Slag Association based on data gathered and compiled by the Problems Committee of the Association.

This book is designed primarily as a useful reference on the subject of blast furnace slag and its contents represent a comprehensive summary of the literature which has accumulated which might be helpful in understanding and more successfully using this by-product of the iron and steel industry.

The content is arranged so that it provides very interesting reading and is supplemented with a large number of illustrations throughout. Of exceptional interest are the early chapters covering the history and development of this material which has now become a well-established aggregate in the construction field. Following a chapter on production and processing, a considerable portion of the book is devoted to chemical and mineralogical composition and to physical properties of blast furnace slag. It is noted that much of the testing and research devoted to this material is closely associated with the work in the technical committees of A.S.T.M. interested in the road and paving field. Several appendices contain very useful data including a reference list of all specifications and methods of test such as A.S.T.M., Federal Specifications Board and AASHO. A comprehensive bibliography concludes this very useful publication. This Bulletin can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at a price of 75 cents.

Calling All Authors

PROSPECTIVE authors are again reminded that the Administrative Committee on Papers and Publications will meet early in February to consider the papers to be presented at the Annual Meeting in Atlantic City, N. J., June 26-30.

All offers of papers should clearly indicate the intended scope and features which, in the opinion of the author, should justify their inclusion in the Society's program.

Suitable blanks for the offers will be forwarded upon request. These offers must be sent to Society Headquarters no later than January 16.

New Members to November 23, 1949

The following 69 members were elected from September 21, 1949 to November 23, 1949, making the total membership 6681.

Names are arranged alphabetically—company members first, then individuals.

Chicago District

BARTHELEMY, C. R., Mechanical Engineer, Pioneer Service and Engineering Co., 231 S. LaSalle St., Room 1100, Chicago 4, Ill.

BOWMAN, CLETUS E., Assistant Professor, University of Illinois, Urbana, Ill.

BOYNTON, A. J., President, A. J. Boynton and Co., 109 N. Wabash Ave., Chicago, Ill.

CULVER, BERNARD W., Pace Associates, 53 W. Jackson Blvd., Chicago 4, Ill.

DALEY, PAUL W., Senior Engineer, All-Steel Equipment, Inc., Aurora, Ill.

JOHNSON, HAROLD D., Research Engineer, The Dexter Co., Fairfield, Iowa.

MUSCATINE, CITY OF, R. J. Halpin, City Engineer, Muscatine, Iowa.

NOTRE DAME, UNIVERSITY OF, DEPARTMENT OF METALLURGY, E. A. Peretti, Professor of Metallurgy, Notre Dame, Ind.

SHADE, C. W., ENGINEER, G & W Electric Specialty Co., 7780 Dante, Chicago 19, Ill.

TRAVER, FRANK C., President and General Manager, Waukesha Rubber Co., Waukesha, Wis.

Cleveland District

SMITH, RICHARD E., Physicist, General Electric Co., Glass Technology Lab., 1133 E. 152nd St., Cleveland 10, Ohio.

Detroit District

HURON PORTLAND CEMENT CO., P. H. Townsend, Vice-President and General Manager, Thirteenth Floor, Ford Bldg., 601 Griswold St., Detroit 26, Mich. [S]†

KUHLMAN ELECTRIC CO., L. F. Goss, Chief Engineer, 1000 Twenty-sixth St., Bay City, Mich.

CHILD, J. LEO, Secretary-Treasurer, Hancock Brick and Tile Co., Box 59, Findlay, Ohio.

JONAS, CARL A., Division Chemist, Socony-Vacuum Oil Co., Inc., White Star Div., 903 W. Grand Blvd., Detroit 32, Mich.

LEGG, FRANK E., JR., Assistant Professor of Engineering Materials and Assistant Supervisor of Laboratory, University of Michigan and Michigan State Highway Dept., 1224 E. Engineering Bldg., Ann Arbor, Mich.

MATHENY, H. RICHARD, Technical Advisor, Ford Motor Co., Parts and Equipment Manufacturing Div., Ypsilanti, Mich. For mail: 20157 Appoline Ave., Detroit 21, Mich.

New England District

MASURY-YOUNG CO., Donald M. King, President, 76 Roland St., Boston 29, Mass.

OWEN, ERNEST V., Consulting Engineer, E. B. Badger and Sons Co., 75 Pitts St., Boston 14, Mass.

ROOS, WILLIAM J., Materials and Standards Engineer, Westinghouse Electric Corp., Sturtevant Div., Hyde Park, Mass. [J]*

ROSHOLDT, ERLING F., Research and Development Chemist, Hamilton Standard Propeller, Division of United Aircraft Corp., Main St., East Hartford, Conn.

TRACY, LAWRENCE JAMES, Structural Engineer, Cleverdon, Varney & Pike, Consulting Engineers, 120 Tremont St., Boston 8, Mass.

New York District

GENERAL ELECTRIC CO., F. M. Clark, General Engineering and Consulting Laboratory, 1 River Rd., Schenectady 5, N. Y.

WHITTAKER, CLARK & DANIELS, INC., W. Wallace Roff, Vice-President, 260 W. Broadway, New York 13, N. Y.

KREGER, JOHN M., Chief Engineer, Valentine Fire Brick Co., Woodbridge, N. J.

SCHULER, HILDEGARD, President, Henry Zuhr, Inc., 187 Lafayette St., New York 13, N. Y.

Northern California District

BLAIR, WALTER A., West Coast Manager, Precision Scientific Co., 582 Market St., San Francisco 4, Calif.

CALIFORNIA STATE DEPARTMENT OF PUBLIC WORKS, DIVISION OF ARCHITECTURE, W. O. Halstead, Box 1079, Sacramento, Calif.

EAST BAY MUNICIPAL UTILITY DISTRICT, 512 Sixteenth St., Oakland 12, Calif.

PORTER, JOHN E., Manager, Metz Aggregate Co., Box 900, Watsonville, Calif.

VALLERGA, BERNARD A., Assistant Professor in Civil Engineering, University of California, 301 Engineering Materials Lab., Berkeley 4, Calif.

Ohio Valley District

FINNERAN, J. E., JR., Vice-President and General Manager, The Columbus Anvil and Forging Co., 117 W. Frankfort St., Columbus 16, Ohio.

Philadelphia District

ATLAS FENCE CO., R. F. Bole, Treasurer and General Manager, Richmond and Pickwick Sts., Philadelphia 34, Pa.

FLYNN, EDWARD S., Research Chemist, Kuljian Corp., 1200 N. Broad St., Philadelphia 21, Pa.

MUSSER, JAY C., Chief Chemical Engineer, Klein Chocolate Co., Inc., Elizabethtown, Pa.

QUINN, JAY H., President, Reading Testing Laboratories, Inc., 245 Poplar St., Reading, Pa. For mail: Box 353, Reading, Pa.

Pittsburgh District

FRICK, WALTER HIRAM, Consulting Engineer, 740 Wallace Ave., Pittsburgh 21, Pa.

HINDMAN, ROBERT P., Works Metallurgist, Armco Steel Corp., Butler, Pa.

MCDANEL, DONALD W., President, McDanel Refractory Porcelain Co., Beaver Falls, Pa.

ROOS, PHILIP K., Associate Professor of Engineering Mechanics, The Pennsylvania State College, State College, Pa. For mail: S. Pugh St., State College, Pa.

St. Louis District

NOOTER CORP., E. William Kleefisch, Development Engineer, 1401 S. Second St., St. Louis 4, Mo.

PECK, DONALD KAY, Engineer in Charge, Test Dept., The Vendo Co., 7400 E. Twelfth St., Kansas City 3, Mo. For mail: 6621 S. Benton, Kansas City 5, Mo. [J]

Southern California District

MILLS IRON WORKS, INC., John G. Kinsey, General Manager, 929 N. Main St., Los Angeles 12, Calif.

BOLLER, LEONARD C., Chief Chemist, Technical Coatings, Inc., 387 S. Arroyo Parkway, Pasadena 1, Calif.

HUTCHESON, ROBERT BELLENDEN, Director, Geological Lab., The Superior Oil Co., 930 Edison Bldg., Los Angeles 13, Calif. For mail: Box 1031, Bakersfield, Calif.

MCCALL, HARRISON H., President, Los Angeles Testing Lab., 1300 S. Los Angeles St., Los Angeles 15, Calif.

Washington (D. C.) District

NATIONAL SECURITY RESOURCES BOARD, LIBRARY, Room 8 1/2, Executive Office Bldg., Seventeenth St. and Pennsylvania Ave., N. W., Washington 25, D. C.

Western New York-Ontario District

FREDERICK, JOSEPH, Chemist, Ozalid, Division of General Aniline and Film Corp., Ansco Rd., Johnson City, N. Y.

GASCHE, FRED, President of Organization, Autoclave Engineers, Inc., 860 E. Nineteenth St., Erie Pa.

KENNEDY, CHARLES F., President, The Kennedy Valve Manufacturing Co., E. Water St., Elmira, N. Y.

U. S. and Possessions

AUGSTEIN AND CO., INC., S., Edward Artim, Director of Laboratory, 15-58 127th St., College Point, N. Y.

CIT-CON OIL CORP., Loren D. Grubb, Chief Process Engineer, Box 1578, Lake Charles, La.

TIMBER STRUCTURES, INC., Verne Ketchum, Chief Engineer, Box 3782, Portland 8, Ore.

ASKEW, ALEXIS W., Superintendent of Research, The Russell Manufacturing Co., Alexander City, Ala. For mail: Box 284, Alexander City, Ala.

CAMPBELL, ALLAN B., Executive Secretary, National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2, Tex.

COMINS, HARRISON D., Assistant Professor of Civil Engineering, Civil Engineering Dept., University of Florida, Gainesville, Fla.

GREENWOOD, J. GORDON, ENGINEER, John W. Henson and Sons, Greenville, Tex.

LINDAU, J. W., III, Professor of Mechanical Engineering, University of South Carolina, Columbia, S. C.

LUTES, HAROLD C., General Manager, Layrite Concrete Products Co., 1225 E. Trent Ave., Spokane 15, Wash.

MCCORMICK, CHARLES R., JR., President, McCormick & Baxter Creosoting Co., 1025 Board of Trade Bldg., Portland 4, Ore.

OREGON, UNIVERSITY OF, LIBRARY, Eugene, Ore.

STARKE, ROBERT C., Engineer, Howe-Baker Corp., 905 Esperson Bldg., Houston 2, Tex.

Other than U. S. Possessions

CANADIAN VICKERS, LTD., P. W. Gooch, Chief Design Engineer, Industrial Engineering Div., Box 550, Place d'Armes Station, Montreal, P. Q., Canada.

COAL RESEARCH INST. (USTAV PRO VEDECKY VYZKUM UHLI), B. G. Simek, Director, 94 Rokoska, Prague VIII, Czechoslovakia.

HADLEY, ALBERT, Managing Director, Plastics and Allied Industries (Pty), Ltd., 239 Maritime House, Johannesburg, South Africa. For mail: Box 2717, Johannesburg, South Africa.

HODGE, W. J., Manager, Standard Portland Cement Co., Ltd., Charbon, N.S.W., Australia.

LABORATORIOS NACIONALES DE FOMENTO INDUSTRIAL, R. Illescas F, General Director, Plaza de la Republica 48, Mexico, D. F., Mexico.

POENSGEN, W. C. F., Technical Director, Christiania Spigerverk, Box 4224, Oslo, Norway.

SINGAL, PRAKASH C., Weaving Superintendent, Swatantra Bharat Mills, Box 348, Delhi, India. For mail: 5 Upper Flat Ganesh Lines, Opp. Pinjarapole, Kishan Ganj Station, Delhi, India.

* [J] denotes Junior Member.
† [S] denotes Sustaining Member.

POOR FISH

Ex-President Hoover in a recent study of governmental wastes pointed out that salmon in swimming up the Columbia River are under the jurisdiction of twelve different Federal Agencies. Fortunately the poor fish do not realize this fact.

PERSONALS • • •

News items concerning the activities of our members will be welcomed for inclusion in the column.

Note—These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.

Personalia in A.S.M., A.W.S., A.I.M.E., and S.N.T.:

Several A.S.T.M. members have been honored by organizations participating in the National Metal Congress held in Cleveland in October. **Arthur E. Focke,** Research Metallurgist, Diamond Chain and Manufacturing Co., Indianapolis, is the new President of the American Society for Metals; **Ralph L. Wilson,** Chief Metallurgist, Steel and Tube Div., Timken Roller Bearing Co., Canton, Ohio, is the new A.S.M. Treasurer; and **E. Gammeter,** Chief Metallurgist, Globe Steel and Tube Co., Milwaukee, is a trustee. **O. B. J. Fraser,** Assistant Manager, Development and Research Div., The International Nickel Co., Inc., New York City, is the newly elected President of the American Welding Society; and **Leslie W. Ball,** Chief, Mechanical Evaluation Div., Naval Ordnance Laboratory, White Oak, Md., is the new President of the Society for Nondestructive Testing. The Chairman of the Institute of Metals Division of the American Institute of Mechanical Engineers is **Prof. F. N. Rhines,** Carnegie Institute of Technology. Other A.S.T.M. members who had an active part in the Congress were **E. H. Dix, Jr.,** Aluminum Research Labs., Aluminum Company of America, New Kensington, Pa., who delivered the A.S.M. Edward De Mille Campbell Memorial lecture; **L. A. Danse,** General Motors Corp., Production Engineering Section, who delivered the S.N.T. Lester lecture; **Marcus Grossman,** Carnegie-Illinois Steel Corp., who was recipient of the A.S.M. Sauveur Achievement Award; and **Edgar C. Bain,** of Carnegie-Illinois, who received the A.S.M. Gold Medal. Other members in the news at the meeting were **John D. Sullivan** of the Battelle Memorial Institute, Chairman of the A.I.M.E. Extractive Metallurgy Division; **H. W. Pierce,** Assistant to President, New York Shipbuilding Corp., who is the First Vice-President of A.W.S. for the coming year; and **Wendell F. Hess,** Professor in Metallurgical Engineering and Head of Welding Laboratory, Rensselaer Polytechnic Institute, Troy, N. Y., who received prizes for technical papers in which he collaborated with other authors.

Several A.S.T.M. members have been elected to office in the Welding Research Council, and a number of our members are serving as Council members. **Comfort A. Adams,** Consulting Engineer and Professor of Engineering, Emeritus, Harvard University, who had been serving as Chairman of the Council since its beginning, was elected honorary Chairman; **H. C. Boardman,** Director of Research, Chicago Bridge and Iron Co., who had served as Vice-Chairman, was elected Chairman; and **A. B. Kinzel,** Vice-President, Union Carbide and Carbon Research Laboratories, Inc., was elected Vice-Chairman. Dr. Adams was the first President of the American Welding Society, and the first Director of the American Bureau of Welding, which position he held until the Bureau was discharged and the Welding Research Council organized under the Engineering Foundation in 1935. In addition to the officers the following A.S.T.M. members or committee members are serving on the Council: **J. J. Crowe, T. S. Fuller, Carl M. Loeb, John P. Magos, Arthur E. Pew, G. A. Reinhardt, Henry S. Walker,** and **A. C. Weigel.**

Robert C. Adams, formerly Principal Chemical Engineer, is now Chemical Engineering Superintendent with the U. S. Naval Engineering Experiment Station, Annapolis, Md. Among his various A.S.T.M. activities, Dr. Adams is a hard-working member of the Administrative Committee on Papers and Publications.

The Atlas Research Laboratories were dedicated recently at Mertztown, Pa., as a memorial to the late Maximillian F. Wirtz, who founded The Atlas Mineral Products Co. in 1892. The new laboratories are staffed by twelve chemists and technicians under the direction of **Raymond B. Seymour** and Joseph Dahle.

Herbert J. Baker is now Construction Engineer, Heidelberg Military Post, European Command, U. S. Department of the Army.

Virgil C. Bartlett, formerly Chief Chemist, Union Portland Cement Co., Devil's Slide, Utah, is now affiliated with the Ideal Cement Co., Ft. Collins, Colo.

The Central Scientific Co. (main office and plant, Chicago, Ill.) has announced a number of changes of personnel and the establishment of Divisions on the West Coast and Canada. One of the men involved, Mr. S. R. Evans, who has been elected Vice-President and Director of Sales, represented the Cenco membership in A.S.T.M. for a number of years. Dr. M. N. States now is the representative. For other news of **Cenco** refer to the "News of Instrument Company Personnel" in this BULLETIN.

J. H. Dillon, Director of Research at the Textile Foundation and the Textile Research Institute, Princeton, N. J., and visiting lecturer in Chemistry at Princeton University, has been elected a fellow of the Textile Institute, Manchester, England. Dr. Dillon has carried out considerable applied research on tyre cord and tyre cord fibers, and has developed and patented certain processes concerned with radioactivity.

Eric Eichwald has been elected Chief Chemist and Research Director of Choldun Mfg. Corp., New York City. He will also continue his present position as Vice-President and Chief Chemist of Arrow Laboratories, Inc., and of F. H. Connoisseurie, Inc.

George J. Frankel, formerly Test Engineer, Arma Corp., Brooklyn, N. Y., is now Chief Engineer, Metaplast Process, Inc., Long Island City, N. Y.

F. P. Hall, Assistant Director of Research, Onondaga Pottery Co., Syracuse, N. Y., and **Herbert Insley,** Chief of the Mineral Products Division, National Bureau of Standards, Washington, D. C., were presented with the Ross Coffin Purdy Award of the American Ceramic Society. The first to be so honored, Drs. Hall and Insley were cited for their outstanding contribution to ceramic literature. They are the authors of the book "Phase Diagrams for Ceramists."

George K. Iwashita is now Manager of Products, General Electric Co., Bloomfield, N. J. He was formerly Director of Research, Seeger Refrigerator Co., Evansville, Ind.

Louis J. Klise, formerly associated with Bornbrock-Anderson-Klise, Moline, Ill., is now engaged in his own consulting engineering practice in Bettendorf, Iowa.

J. F. Leonard, for many years representative of the American Railway Engineering Association, Chicago, on Committees C-1 on Cement and C-13 on Concrete Pipe, has retired from active service.

Pauline Berry Mack, Director of the Ellen H. Richards Institute and Professor of Household Chemistry, School of Chemistry and Physics, Pennsylvania State College, State College, Pa., has been chosen as the 1950 recipient of the American Chemical Society Garvan Medal, to be presented next April at the national A.C.S. meeting. Her chief personal contribution to chemistry, according to the recommendations, is in the calcium chemistry of bone density, on which problem she has worked for 22 years, having undertaken it in an attempt to develop a method of measuring calcium retention in bones of living subjects through roentgenograms. Her work has had wide recognition and acceptance both at home and abroad. Prof. Mack has been affiliated with A.S.T.M. for many years, being active in the work of Committees D-12 on Soaps and D-13 on Textiles.

Paul MacMurray has been appointed Chief of the City of Philadelphia Bureau of Highways and Street Cleaning. He succeeds Dudley T. Corning, who headed the Bureau since 1928 and who resigned because of illness.

Marathon Corp. recently opened its new central research laboratory at Rothschild, Wis. One of the most modern research installations in the wood, paper, and pulp industry, the new laboratory will be used for fundamental and applied research pertaining to the company's products, particularly those relating to wood, pulp, paper, and lignin products. The three-floor building is of steel, reinforced concrete, and brick, with Indiana limestone trim, and contains floor space of approximately 24,000 square feet.

Before this BULLETIN is off press the President of George D. Wetherill and Co., Inc., Philadelphia, **Robert W. Matlack,** will be in the harness again, but we will record that on November 16 early in the morning he joined the list of A.S.T.M. members who lost their appendixes at some unearthly hour. Bob is President of the Federated Paint and Varnish Production Clubs, and is also serving as Chairman of the Program Committee of the Exhibit Managers Association which is holding its meeting in Philadelphia December 8 and 9.

Robert F. Mehl, Director of the Metals Research Laboratory and Head of the Department of Metallurgical Engineering, Carnegie Institute of Technology, and **R. A. Wilkins,** Vice-President in Charge of Research and Development for Revere Copper and Brass, Inc., Rome, N. Y., have been appointed honorary corresponding members by The British Institute of Metals.

Tinius Olsen, 2d, Vice-President, Tinius Olsen Testing Machine Co., Willow Grove, Pa., was married on November 12 to Miss Janet Parkhill Bates. Just prior to the affair Tinius had excused himself from attending a meeting of the Philadelphia District Council, of which he is the efficient Secretary, giving as his excuse "urgent business." The real reason is now out. All those who know Tinius will extend him and his new "boss" their very best wishes. The Olsen, 2d, residence is Washington Lane, Rydal, Pa.

Robert W. Orr, formerly affiliated with Radio Corp. of America in Camden, N. J., is now in the Engineering Department of the Erie Resistor Corp., Erie, Pa. Very active in A.S.T.M. work for many years, Bob was at one time Secretary of the Philadelphia District Council, is a Past-Chairman of Committee D-9 on Electrical Insulating Materials, and now serves on the Administrative Committee on District Activities.

Arnold E. Pavlish has been appointed Technical Director of the Kelley Island Lime and Transport Co., Cleveland, to succeed the late Russell G. Greeves. Mr. Pavlish comes to Kelley Island from Battelle Institute, where he conducted and supervised research in chemical technology for 14 years.

Walter J. Purcell, formerly on the staff of the Department of Engineering, Cornell University, is now Assistant Professor, School of Engineering, Seattle University, Seattle, Wash.

Charles H. Samson, Jr., formerly Architects' Field Representative, Matteson, Ill., is now Asst. Instructor, Civil Engineering Dept., University of Missouri, Columbia, Mo.

William Boyd Shannon has been appointed Chief Generation Engineer, British Electricity Authority, Kingston-upon-Thames, Surrey, England. He was previously associated with the London Power Co., Ltd., London, England, as Chief Assistant Constructional Engineer.

Jens Sivertsen is now Research Engineer at Goodyear Aircraft Co., Brimfield, Ohio.

Charles D. Townsend, formerly Chief Industrial Engineer, A. B. Chance Co., Centralia, Mo., is now affiliated with Associated Engineers, Inc., Fort Wayne, Ind., as Industrial Engineer.

L. B. Tuckerman, Assistant Chief, Division of Mechanics and Sound, National Bureau of Standards, retired on September 30 after a record of distinguished service on the research staff of the Bureau. Widely known for his important work in the mechanics of materials and structures, Dr. Tuckerman has been very active in A.S.T.M., serving on various technical committees, and in 1935 delivered the Edgar Marburg Lecture on the subject "Aircraft: Materials and Testing." He has won many medals including citations from the Manhattan District and from the Office of the Surgeon General of the War Department for work in World War II. His activities have covered a wide range of subjects including the measurement of stresses and strains, and the perfection of the Tuckerman optical strain gage, safer airship and aircraft design, spectrophotometry, and the development of an improved artificial knee. He has been active in the Boy Scout movement and other educational work.

L. J. Venuto, Research Director, Binney & Smith Co., New York City, is on a European tour making a detailed survey of the ink and paint industries in England, France, Germany, Italy, and Switzerland.

Stanton Walker, Director of Engineering of the National Sand & Gravel Association and the National Ready Mixed Concrete Association was honored in October at a dinner at the Biltmore Hotel, Los Angeles, arranged by the Southern California Rock Products Association and the Southern California Ready Mixed Concrete Association. The tribute was planned to coincide with Mr. Walker's visit to the Pacific Coast primarily to participate in the A.S.T.M. National Meeting in San Francisco. Mr. Walker, who has directed for a quarter of a century the research activity programs of the two national associations, is a longtime A.S.T.M. member. He has an outstanding record of past and continuing services to the Society.

NECROLOGY

DAVID BASCH, Representative, U.S.A., Almin Limited of Great Britain, Schenectady, N. Y. (October 3, 1949). Representative of Almin, Ltd. membership from 1946 to 1948, and personal member since 1948. Member of Committees B-3 on Corrosion of Non-Ferrous Metals and Alloys, B-6 on Die-Cast Metals and Alloys, and B-7 on Light Metals and Alloys, 1946–1949; and previously member for many years of several of the "B" committees as representative of General Electric Co. and the National Electrical Manufacturers Assn.

A. W. K. BILLINGS, retired President, Brazilian Traction, Light and Power Co., Ltd., of Toronto, Canada, and Rio de Janeiro, Brazil; and recently residing in Winnetka, Ill. (November 3, 1949). Mr. Billings joined A.S.T.M. in 1915 when associated with the Ebro Irrigation & Power Co., Ltd., Barcelona, Spain. From 1921 to 1924 he was with the Canadian & General Finance Co., Ltd., Toronto, and in 1924 became affiliated with the Brazilian Traction, Light and Power Co., serving successively as Vice-President and President, and retiring in 1948.

W. G. CONANT, General Electric Co., Schenectady, N. Y. (August 27, 1949). Representative of his company since 1938 on Committees A-10 on Iron-Chromium, Iron-Chromuim-Nickel and Related Alloys, E-4 on Metallography, and E-17 on Non-destructive Testing.

P. DIEDERICH, Superintendent, City of Glendale, Public Service Department, Glendale, Calif. (November 1, 1949). Representative of membership of Glendale Public Service Department since 1932.

KENNETH S. HALL, formerly Paving Consultant, Portland Gas and Coke Co., Portland, Ore. (September 28, 1949). A member since 1946, Mr. Hall died after an illness of many months.

JOSHUA L. MINER, Vice-President (Retired), Lumnite Div., Universal Atlas Cement Co., New York, N. Y. (October 7, 1949). A resident of Plainfield, N. J., Mr. Miner died in that city at the age of 67. Joining the cement company in 1922, Mr. Miner had become identified in 1924 with a subsidiary company, the Atlas Lumnite Cement Co. as Manager of Sales, Production and Research; in 1937 he was elected Director and Vice-President of that subsidary, and when the subsidiary became the Lumnite Division of Universal Atlas Cement Co., he was elected Vice-President, which position he held until his retirement in October, 1947. During World War I, Mr. Miner served in a supervisory capacity with the Chief of Inspection, Purchase, Storage and Traffic, General Staff, U. S. Army. During World War II, he was Chairman of the Technical Advisory Committee of the Cement, Lime and Gypsum Division of the War

Production Board. Affiliated with A.S.T.M. since 1912, Mr. Miner had been a member of Committee C-1 on Cement for more than thirty years; had served on the Society's Executive Committee (1941–1943) and at the time of his death was serving on the Administrative Committee on Standards. He was also a member of the American Concrete Institute and was the author of several important papers on cement and concrete.

In addition to his professional activities, Mr. Miner had served as Councilman and President of the Council of the City of Plainfield, N. J., on the Board of Governors of Muhlenberg Hospital in Plainfield, as Deacon and Elder of Crescent Avenue Presbyterian Church, and had been prominently associated with municipal activities in his home community.

JOHN TUCKER, JR., Chief of the Concreting Materials Section, Mineral Products Division, National Bureau of Standards, Washington, D. C. (November 20, 1949). Mr. Tucker had actively directed the research and testing of the Concreting Materials Section since 1926. He was well known for his work on the statistical theory of strength, particularly as applied to concrete beams, and was recipient in 1942 of the Sanford E. Thompson Award of A.S.T.M. Committee C-9 for his paper "Statistical Theory of the Effect of Dimensions and of Method of Loading Upon the Modulus of Rupture of Beams." He had served on various subcommittees of A.S.T.M. Committee E-1 on Methods of Testing, and was a Consulting Member of Committee E-11 on Quality Control of Materials.

R. J. WHEELER, Chief Metallurgist, Carter Traveler Co., Gastonia, N. C. (October 18, 1949). Representative of company membership since 1945, also represented his company on Committee B-5 on Copper and Copper Alloys.

FRED L. WOLF, retired, a former Director of the American Foundrymen's Society, and for many years Technical Superintendent of the Ohio Brass Co., Mansfield, Ohio (September 27, 1949). A personal member of the Society 1944–1948, Mr. Wolf previously had served for many years on various of the ferrous and non-ferrous technical committees, as representative of AFA and the Ohio Brass Co., also was a member of the Cleveland District Council for several years. During the war he served as Chief of the Mica, Graphite, and Rare Minerals Division of the War Production Board and later accepted appointment as a member of a committee appointed by the Technical Industrial Information Committee to report on non-ferrous foundries, ingot producers, and pearlitic malleable producers in Germany and England.

Notes on Laboratory Supplies

Catalogs and Literature; Notes on New or Improved Apparatus

This information is based on literature and statements from apparatus manufacturers and laboratory supply houses.

Catalogs and Literature

Leeds & Northrup Co., 4902 Stenton Ave., Philadelphia 44, Pa. The recent issue of the eight-page folder "Modern Precision" describes the use of Leeds & Northrup instruments in growing of synthetic piezo-electric crystals, pH control guides, and notes instruments used in work near absolute zero.

The Baldwin Locomotive Works, Philadelphia 42, Pa. This twelve-page catalog is entitled "SR-4 Strain Gages, Instruments and Accessories" and is illustrated by line drawings distinguishing eleven types of gages and listing 102 standard gages. The gages are classified by types of wire and cementing materials to be used. The catalog also lists prices of all SR-4 equipment and accessories used with the gages. A list of things to consider in the selection of SR-4 strain gages with references to Baldwin bulletins in which further information can be obtained, is also included.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa. A new booklet describes the company's complete line of "Utilized" Laboratory Furniture which can be installed easily and quickly either as single units or complete laboratory arrangements. Illustrations show the 18 standard pieces of furniture both as single units and as they are used in typical assemblies in various laboratories. A helpful feature is a group of typical layouts for specific uses and restricted areas. 20 pages.

The Posey Iron Works, Inc., Lancaster, Pa. A twelve-page booklet describes and illustrates The Posey Iron Works—formerly Lancaster Iron Works. Various divisions and departments of the company are illustrated and described—namely, Engineering Department, Steel Plate Division, Machine Shop, Brick Machinery Division, The Foundry, Industrial Heating Division, Steel Form Division, Iroquois, and Shipbuilding Divisions. The company manufactures autoclaves, condensers, countercurrent rapid batch mixers, crushers, steam-jacketed pumps, dehydrators, ovens, pressure vessels, welded and riveted pipe, etc. Illustrated.

The Emil Greiner Co., 20–26 N. Moore St., New York 13, N. Y. A four-page folder describes new inexpensive Bacharach laboratory instruments, including gas analyzers for carbon dioxide and oxygen, recording barometer, and thermometer, air velocity meter, smoke analysis apparatus, plastic graduate, etc. Illustrated.

Soil Testing Services, Inc., 730 Madison Street, Evanston, Ill. Specification sheets describe complete line of soil-testing equipment including unconfined compression devices, McRae motorized soil lathe, triaxial shear apparatus, sample ejector, consolidation specimen trimmer, power hack saws, soil-mixing machines, compaction mold, standard rammer, Consolidometer, rotary trimming tolls, permeameters, Tyler sieves, and others. Descriptions of operation, construction, and advantages are provided for each device.

Thwing-Albert Instrument Co., Pulaski Ave. at Penn St., Philadelphia 44, Pa. There is an interesting discussion in the series "Facts About Paper Testing" dealing with basis weight. Covers definitions, conversion tables and formulas, and pertinent discussion on the basis weight scale. Prepared by E. J. Albert, and well worth reading. Four pages.

The Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill. Bulletin 182-49 entitled "Automatic Circular Dividing Machine" describes and illustrates a fully automatic machine for production ruling of precision circular scales according to any standard pattern of lines having industrial or scientific application. Method of operation and construction of the machine are briefly outlined. Detailed specifications are given.

Applied Research Laboratories, 4336 San Fernando Road, Glendale 4, Calif. A technical paper is available describing the new direct reading method for chemical analysis of stainless steels. The method described is fast, and indicated as having a very high precision for a spectrochemical system.

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. "The Experimenter," October, 1949—eight pages—includes two articles covering "A Smaller Variac Speed Control" describing Type 1700 Variac Speed Controls for applications requiring up to about $\frac{1}{15}$ hp. output. Circuit details, construction, performance, etc., are mentioned. The second article covers "Returning Instruments for Repair."

Instrument Notes

The Baldwin Locomotive Works, Philadelphia 42, Pa.—Several new instruments have been developed recently, as follows:

- Five new SR-4 Type Load and Pressure Cells, extending the range of standard models on both high and low sides.
- Two New Compression Type Load Weighing Cells of 100,000 and 200,000 lb. capacity.
- Eleven sizes of SR-4 Fluid Pressure Cells.
- Baldwin Load Cells of Hydraulic and Pneumatic Types.
- Strip-Chart Strain Recorder for use in stress analysis with SR-4 bonded resistance wire strain gages.

Universal Testing Machine (Model 60-H) of 60,000 lb. capacity with two ranges.

Pipe Tester of 200,000 lb. capacity for testing sewer pipe and structural materials.

GFB-NBS Strain Tester for Rubber and Rubber-like Compounds—G. F. Bush Associates, Princeton, N. J. This tester measures the per cent elongation of a virtually motionless specimen at a definite time after the application of a prechosen stress, psi. This stress is obtained by loading the specimen friction-free in proportion to its thickness in millimeters. Predicts cure time, measures extension set for a specified stress, general aid in production and laboratory control and testing of rubber and rubber-like compounds, including plastics.

New Autopositive Film—Eastman Kodak Co., Rochester 4, N. Y. This film is used for making reproductions of engineering and architectural drawings and of maps and physical surveys. It is known as Kodagraph Autopositive Film, and may be handled in normal room light and produces a positive copy directly from a positive original drawing, without a negative step. It may be exposed on blueprint or whiteprint equipment or other copying machines having a high-intensity light source. The film provides maximum print-back speed because of its translucent support and easily retains fine lines and minute detail because of the high resolving power and contrast of the silver-sensitized emulsion.

Portable Water Bath—Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa. A valuable feature of this Water Bath, which weighs only 24 lb., is a novel device which prevents it from "going dry." The bath accommodates a wide variety of laboratory glassware, and incorporates integral rod-and-clamp arrangement. The bath has a Monel exterior and tinned copper interior for resistance to corrosion. It employs two immersion type heaters, either or both of which can be used for low or high heat. A special bottle-feed device prevents the bath from "boiling dry" for as long as 10 hr. on low heat and 4 to 5 hr. on high heat.

Safety Pouring Spout—Fisher Scientific Co. This is for use with standard five-pint acid bottles or one-gallon jugs. The spout has a design which vents air into container as liquid is poured out, thus preventing the danger of splashing, spilling and "after-drip" common when pouring directly from bottle. It is furnished with a washer by means of which it is adaptable to fit all types of acid bottles now used, and with a closure cap. It is made of polyethylene, a plastic that is resistant under 60 C. to all ordinary acids and alkalies as well as most organic compounds.

Automatic "Besjet" Pocket Size Alcohol Blow Torch—The Emil Greiner Co., 20-26 N. Moore St., New York 13, N. Y. This is especially designed for the laboratory and may be employed in applications where heavy, expensive, standard size blow torches are neither practical nor efficient. Completely automatic, it requires no priming or pumping. Light it and it gives a 6-in. flame of 1800 F. in 10 seconds. It is constructed of sturdy brass with triple plates chrome finish, and is leakproof with no moving parts to get out of order.

Lucite Bell Jars—The Emil Greiner Co. These jars are designed especially for use in testing laboratories to replace glass and minimize breakage. Recommended for observation and protection tests and testing under vacuum. Two sizes—large and small.

Hagan Automatic Degasser—Hagan Corp., 411 Seventh Ave., Pittsburgh 19, Pa. A new device designed primarily for use in determination of steam purity. It produces continuously and automatically an approximately 50–50 split of a flowing steam sample—one fraction of the condensed steam containing any dissolved solids that may be present, and the other any dissolved gases. A principal advantage is the degasser's automatic operation. It does not require valve-twisting or frequent attention.

Container for Liquid Hydrogen—Hofman Laboratories, Inc., 212 Wright St., Newark, N. J. This container is for the storage and transport of liquid hydrogen and liquid helium. It is made of three concentric copper spheres. Very useful in research laboratories where liquid hydrogen or helium must be kept available for research work.

Ther-Monic Foundry Core Baking Tunnel—Induction Heating Corp., 181 Wythie Ave., Brooklyn 11, N. Y. This Model M-285AD Tunnel is a low cost unit with a capacity of 375 lb. of cores per hour and capable of handling cores up to 16 in. wide by 7 in. high. The unit has a variable speed dial feel, adjustable electrodes, and a complete blower exhaust system. It is designed for the small foundry and is so arranged that both loading and unloading may be readily handled by the same core maker.

Panel Meter with Interchangeable Face Plates—International Instruments, Inc., New Haven, Conn. This meter has interchangeable face plates. The meter has been designed to meet Government specifications, can be supplied with either a watertight seal, or a hermetic seal with solder sealed terminals and crystal. One of the features of this instrument is the wide variety of ranges available as a completely self-contained instrument.

Speedomax Recorder—Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. This Recorder now automatically plots the relationship between two variables, showing one as a function of the other. Variables to be plotted are converted d-c. signals, and connected to the instrument, one to the horizontal axis and the other to the vertical axis. The result is a permanent record, accurately plotting in minutes data that would require hours using the usual point by point method.

Lindberg Volumetric Carbon Determinator—Lindberg Engineering Co., 2443 W. Hubbard St., Chicago 12, Ill. Latest design features and construction definitely help to accomplish faster and more accurate determinations of carbon in irons, steels, heat-resisting steels, stainless steels, etc. Graduated water-jacketed burette provides accuracy to within one point of carbon or better. Leveling bottle is free from encumbrances and has an integral side arm tube for easier meniscus readings. Pyrex glassware is used throughout and stand is attractively finished in glossy grey baked enamel.

Lindberg "H-F" Combustion Unit—Lindberg Engineering Co. This Type LI-500A is a completely new induction heating unit designed specifically for laboratory use in carbon determination, both gravimetric and volumetric. It is particularly useful for sulfur determinations because of the high temperatures available. It provides radio frequency energy from a stable electronic circuit similar to that used in large industrial type induction heaters. This model introduces a new method of heating iron and steel samples in a transparent combustion tube.

New 750-lb. Testing Machine—National Forge and Ordnance Co., Irvine, Pa. This machine is for making standard crush tests of boxboard and for flexure and compression tests of a variety of small containers, drums, and other parts and articles. It is adaptable to general compression testing of springs, flexure tests of plastics, glass, ceramics, insulation board, plywood, and a variety of other materials and finished articles.

Vari-Temp Ductility Apparatus—Precision Scientific Co. This was developed for testing bituminous roofing and paving materials in accordance with A.S.T.M. Method D 113. Ease of operation is featured in having one temperature control knob, one lever for pull speed selection, and one lever for start-stop of carriage. There are three pulling speeds, ½, 1, and 5 cm. per min. Three samples can be tested simultaneously, and a large storage compartment has space for conditioning eight samples. The samples are pulled over a full-length "milk" glass panel with no carriage sway or chatter. Carriage is automatically stopped by a micro switch at end of 150 cm. travel.

Scott Tester Model E—Brittle Point Tester—Scott Testers, Inc., 101 Blackstone St., Providence 1, R. I. The purpose of this instrument is to perform the brittle point test (in conformity with A.S.T.M. Method D 746) upon vulcanized rubber and other elastomers. It operates on a solenoid actuated guillotine principle with the prescribed standard test piece, introducing a new standard of quietness in operation. It is compact and light in weight so as to be readily portable.

X-ray Thickness Gage—Westinghouse Electric Corp., Pittsburgh 30, Pa. This new gage is designed to measure in steps of 0.0001 in. cold rolled steel strips ranging in thickness from 0.0050 in. to 0.1190 in. The gage compares the amount of X-ray absorption from two X-ray beams identical in intensity, one through a sample of steel of the exact thickness to be rolled, and the other through the steel strip being rolled. The results are interpreted visually.

News of Instrument Companies

J. W. Dice Co., maker of nondestructive and physical test instruments, which has been located in Nyack, N. Y., for the past couple of years, is moving to Englewood, N. J., where a permanent home for the company will be established.

E. H. Sargent & Co., formerly located at 155 E. Superior St., Chicago, Ill., have moved into a new office and plant covering three acres—with engineering laboratories, instrument and glass working departments, warehousing and merchandise handling facilities available—their new address being 4647 W. Foster Ave., Chicago 30, Ill. Constructed in modern style, the new one-story steel, concrete, and brick building has acoustic ceilings and tile floors, air conditioning, and Thermopane glass windows. Adjacent to the general offices are a city sales room; lecture and projection room; scientific library; show room; first aid room; and plant cafeteria with kitchen. This company is a leading distributor and manufacturer of scientific laboratory instruments, apparatus, and chemicals, has been in business since 1852. T. M. Mintz is President of the company, and the representative of the company's membership is Mr. Paul Sherrick, Treasurer and Officer in Charge of Research and Production.

Central Scientific Co. of Chicago has announced the acquistion of Redman Scientific Co., and the assets and business of the Pacific Laboratory Apparatus and Chemical Co. Redman Scientific Co. will now operate in California, north of the Tehachapi Mountains, in Washington, Oregon, Nevada, Utah, Idaho, and Western Montana, as the Redman Division of Central Scientific Co. of California. Offices are located at 16 Beale St., San Francisco 5, Calif. Pacific Laboratory Apparatus and Chemical Co. will now serve the state of California, south of the Tehachapi Mountains, Arizona, and New Mexico, as the Pacific Laboratory Division of Central Scientific Co. of California. Offices are located at 3555 Whittier Boulevard, Los Angeles 23, Calif. The company has announced the election of S. R. Evans as Vice-President and Director of Sales, and H. V. Cadwell as Director of Purchases. Sterling L. Redman will manage the Redman Division of Central Scientific.

Society Appointments

Announcement is made of the following appointments:

Neil A. Fowler, General Box Co., as Society representative on the Packaging, Storage, and Materials Handling Industry Advisory Committee of the Munitions Board.

R. F. Blanks, Bureau of Reclamation, Denver, Colo., as Society representative at the ceremonies on the occasion of the Seventy-fifth Anniversary of the Colorado School of Mines, Golden, Colo., September 29 through October 1.

Bureau of Standards Notes

Recent announcements from the Bureau of Standards cover oppointments to the staff of Drs. Richard N. Work and Robert S. Marvin. Dr. Work will concentrate his activities on dimensional changes in natural and synthetic rubbers under changing temperatures, and Dr. Marvin is to study the dynamic-mechanical behavior of rubberlike materials.

An announcement of the retirement of Dr. L. B. Tuckerman after thirty years of service in the Bureau, appears in the Personals column of this Bulletin. He was very active and widely known in A.S.T.M.

Physics Institute Appoints Executive Secretary

Wallace Waterfall, formerly Director of Research and Product Development for the Celotex Corp., has been appointed to the newly created position of Executive Secretary of the American Institute of Physics. Mr. Waterfall has served as a member of the Governing Board of the Institute since 1934 and as Secretary of the Board since 1945. Secretary of the Acoustical Society of America since its founding in 1929, and Secretary-Treasurer of the Acoustical Materials Association concurrently, Mr. Waterfall will resign only his office as a member of the Governing Board of the Physics Institute. Mr. Waterfall has represented the Celotex Corp. in its A.S.T.M. membership for a number of years, and as a representative of the Acoustical Materials Association is currently a member of the recently organized A.S.T.M. Committee C-20 on Acoustical Materials, serving also as chairman of its subgroup on Fire Resistance.

Bibliography of Paper Making and U.S. Patents, 1948

The Technical Association of the Pulp and Paper Industry has released a publication entitled, "Bibliography of Paper Making and United States Patents, 1948." This has been compiled by Clarence J. West, Chairman, Committee on Bibliography, TAPPI, and Research Associate and Editor, The Institute of Paper Chemistry. This book contains references to the literature on paper and paper manufacture published during the year 1948 and the United States patents received during that year. It is arranged in sections containing a list of journals covered, bibliography, patents, and author, subject and patent indexes. For further information it is suggested that contact be made with the Technical Association of the Pulp and Paper Industry, 122 East 42nd St., New York City.

F.B.I. Register of British Manufacturers—1948–1949

The twenty-first edition of this Register by The Federation of British Industries, founded in 1916, contains the names and addresses of nearly six thousand firms listed under headings covering more than five thousand products.

The 752-page volume is composed of the following sections: a Products Section, containing a list of member firms classified by products and services and a list of member associations classified by industries; an Advertisements Section; an Addresses Section, containing an alphabetical directory of the addresses of member firms and associations; a Brands and Trade Names Section, with indication of products and their manufacturers; and, finally, a Trade Mark Section, also with indication of products and their manufacturers.

Inquiries concerning copies of the Register may be made to F.B.I. Register, Iliffe & Sons, Ltd., Dorset House, Stamford Street, London S.E.1, England.

A. E. S. Research Reports Available

Complete sets of the American Electroplaters' Society Research Reports published to date are now being offered by this organization at a group price of $5 as long as the supply lasts. The set of 14 reports includes the following:

Reports Nos. 1, 2, and 8—The Adhesion of Electrodeposits
Reports Nos. 3 and 6—Determination of Impurities in Electroplating Solutions (Complete for nickel plating baths)
Reports Nos. 4 and 7—Stripping of Copper from Various Base Metals
Reports Nos. 5 and 10—Porosity of Electrodeposited Metals
Reports Nos. 9 and 14—Disposal of Plating Room Waste
Report No. 11—Method of Testing Thickness of Electrodeposits
Report No. 12—Physical Properties of Electrodeposits
Report No. 13—Effect of Impurities and Purification of Electroplating Solutions

Inquiries should be addressed to: American Electroplaters' Society, P. O. Box 168, Jenkintown, Pa.

Graduate School of Industrial Administration

Nearly six million dollars in cash and securities was given recently to the Carnegie Institute of Technology by the W. L and May T. Mellon Foundation to establish the nation's first graduate School of Industrial Administration. It is hoped that the school will fill a great need for administrators whose business training is strengthened by the capacity to understand technological elements of financial, personnel, and administrative questions. It is estimated that 50 per cent of technical engineering graduates, after forty years of age, are found in positions of administrative responsibility in industry today.

Round Table Discussion on the Need for Standards for the Examination of Water-Borne Industrial Wastes*

Introduction

By L. Kermit Herndon[1]

THE scope of the work of A.S.T.M. Committee D-19 on Industrial Water has properly included the study of various types of industrial water flowing through a manufacturing establishment. Hitherto, the work has been confined largely to boiler feed water or waters for process use and the deposits resulting from their contact with materials of construction. However, attention is now being given to the problems involved in the industrial wastes carried by these waters. Much of the work already done is applicable in this new area, and it remains to extend standard methods to cover the broader definition of industrial waters.

The questions might well be asked as to why this work should be done; and, in particular, why should Committee D-19 of this Society be concerned with the work? First, there is not now available an authoritative reference work covering the measurement, sampling, analysis, and characterization of water-borne industrial wastes. Other organizations have done and are doing work on the problem of stream pollution and the effects of industrial wastes upon public water supplies, sewage treatment, plants, and the like. These include Federal and state authorities, chiefly in the public health departments, and by organizations having membership among those employed in this work—American Public Health Association, American Chemical Society, American Water Works Association, and Federation of Sewage Works Associations. Industrial groups such as the American Petroleum Institute, Technical Association of the Pulp and Paper Industry, American Steel and Iron Institute, and many others have been concerned with problems of wastes within their own industries. It is with these latter that there is the closest relationship. Committee D-19 is interested in the wastes within the confines of a plant and not in inspecting a stream below the plant. Some of the techniques, of necessity, are applicable in each case, but stream pollution is left for the sanitarian. Within the operating techniques of the A.S.T.M. its standards are carefully developed by representatives of producer, consumer, and general interests, based upon careful research within the industries, universities, and governmental agencies. Its standards have been recognized among the technical professions. The work of Committee D-19 is done under the conditions imposed by the Society, and within its membership is found wide representation of the interests noted above. The Society believes that it is a desirable field of work within the scope of Committee D-19.

Committee D-19 has organized a Subcommittee VII for handling the work and has divided it into four sections as follows:

Section A.—Critical Constituents of Water-Borne Industrial Wastes
Section B.—Analytical Methods for Industrial Wastes
Section C.—Methods of Sampling, Gaging, and Preservation of Samples
Section D.—Methods of Reporting Analytical Results

There is no section set up for standards of pollution, nor is there one for the determination of permissible limits for pollution. It is the province of this committee to furnish the standard methods by which the industry and the authorities may determine what quantity of industrial waste a plant produces and what its characteristics are and *not* to define what and how much constitutes pollution.

The pattern of action of the subcommittee will coincide closely with that of the main committee, and many of its problems will be considered by other subcommittees where existing standards need but little change to broaden their scope to include the industrial wastes.

Special mention should be made of Section A in order to show some of the planning involved. It is the purpose of the section to study the feasibility of adopting one or more key determinations that will characterize an industrial waste. It is expected that these test methods will relate to the waste materials themselves rather than to a specific result of their entrance into a stream of water, a divergence from stream pollution study techniques. It is obvious that an attempt to perform a complete chemical analysis upon a waste would in some cases not only be laborious and time consuming but also relatively uninformative. The characterization of a waste by a key component or test to serve as an index upon the waste will, we believe, simplify the matter and yet give the desired information. Since, in most cases, the wastes themselves are known within the plant, the problem is different from that of a sanitarian confronted with the measurement of a complex system in a stream.

The details of the status of present methods for sampling and gaging of industrial wastes and the need for uniformity of methods of analysis and reporting them will be given in subsequent papers on this Session. Our purpose in having these papers is to bring here for discussion the present situation within these fields of work so that we may plan for future activities.

* Presented at the Fifty-second Annual Meeting, Am. Soc. Testing Mats., Atlantic City, N. J., June 30, 1949.

[1] Professor of Chemical Engineering, The Ohio State University, Columbus, Ohio.

Analysis of Water-Borne Industrial Wastes: The Need for Uniformity in Methods of Analysis and Reporting

By George D. Beal[1] and S. A. Braley[1]

THERE are at least two sound reasons for the sequestration and treatment of water-borne industrial wastes. One, of course, is the matter of public policy; whether in the words of Abel Wolman, we have the right to sweep our dirt under another housekeeper's rug. The other, less thought of but equally important, is industry's need for clean water. This need determines the geographical location of industries and requires that many wastes present in the water at the intake be removed before the water is fit for industrial use. Therefore, it becomes a question whether one user shall remove another's wastes from his own water supply or each user remove his own wastes from his own effluents, returning clean water to the stream.

A consideration of the subject reveals that what we are thinking about is somewhat akin to ash removal from a power plant—or to the many janitorial services required around any type of mill. For example, there is an obvious necessity for sweeping away borings and turnings in a machine shop so the machinists can use their tools properly. But any waste which water will carry is seldom thought of by the maintenance department as within its province.

Politically, the whole problem of industrial wastes is best described as a "hot potato." Municipal governments make the presence in streams of industrial wastes, especially the contamination by mine acid, an excuse for slothfulness in their building of sewage-disposal plants. On the other hand, owners of factories say that their wastes are excusable as being relatively innocuous if compared to sewage. As long as the public is willing to drink and use for washing a poorly treated water supply, it should have little objection to the relatively sterile waste water contaminated mostly by inorganic matter from commercial chemical operation. We may be assured, however, that public interest will in the end prevail.

We do have garbage and ash collections, pasteurized milk, quarantining of communicable diseases, smoke control, and numerous other measures provided for the health and comfort of our population. In the not too distant future, public interest will require other disposal of wastes, now water-borne, regardless of their source. Many streams are not more of a nuisance today only because of the balancing effects of the various kinds of wastes present.

For many steps in elimination set up a degree of unbalance and make nuisances even more objectionable. There is a city not far from Pittsburgh that uses an open creek in lieu of a trunk sewer. The drainage from three large mines, ranging in volume according to season from four to seven million gallons daily, is also pumped into this creek. It is only the acidity of this mine drainage that inhibits putrefaction of the sewage. Now, with the possibilty in the offing that mine pumping will be stopped, the city government is considering buying or leasing those abandoned workings in order that it may continue to add that acid water to the city's sewage, as a prophylactic, pending the time when the city government can complete a modern sewage disposal plant.

This commingling of sewage and mine drainage takes care of the area immediately surrounding this city just as other industrial wastes have their inhibiting effect on other cities' sewage. But as these streams flow on they receive other streams, often naturally akaline, so that dilution and neutralization soon reduce the bactericidal and bacteriostatic effect of these industrial wastes. Because of this neutralization, new infection in the stream permits a resumption of sewage decomposition in areas that should be clean. Therefore, we may be sure that problems involved in the treatment of water-borne industrial wastes, rolling up like a snowball, are going to be among the tremendously important industrial problems of the next decade.

When we examine the problem of analysis of waste-laden water we find that most of the chemical studies made to date have been by procedures developed for the examination of potable or boiler-feed waters, or of the effluents of sewage disposal works. Sanitary sewages have much in common, one characteristic feature being their nitrogenous content, which leads to their putrescibility. Industrial wastes, on the other hand, may run to all of the extremes known to organic and inorganic chemists. Consequently, procedures based upon sanitary sewage and standards of quality based upon such procedures may lead to erroneous conclusions if applied to industrial wastes.

Most of the analytical procedures applied to industrial water today determine the suitability of water for some particular end-use or group of end-uses. Actually, they determine whether the water falls within a group of tolerances that experience has shown to bracket the properties that water for the desired uses must have. After producing a water within the desired tolerances, special treatments may then be applied to any part of the supply to fit it for more specific industrial uses such as laundering, boiler feed, ice making, etc.

If the water is for a municipal supply the main consideration is potability. But there also must be assurance that the water will not corrode the pumping and distributing system. This is not said in jest but is merely a recognition of the enormous buffering and balancing capacities of the animal body reactions opposing the sensitive reactions of individual metals and alloys to acids and alkalies.

The testing of water to determine suitability for end-uses has led to the development of empirical methods of analysis, which are implemented with calculations using factors that specify the required degree of treatment rather than chemical composition. Such analytical procedures are operators' methods, for use solely in guiding plant operations. Although these methods are based upon and employ chemical reactions, they do not represent chemical control, but only operational control. They are devised for technicians rather than chemists, watchmen rather than diagnosticians.

The analysis of water from wells, rivers, and lakes commonly available as sources for commercial water supplies usually deals with relatively low concentrations of critical constituents. The study of water-borne industrial wastes usually deals with relatively high concentrations.

In our opinion, the types of analytical procedures that should be available for these water-borne wastes are those

[1] Assistant Director and Senior Fellow, respectively, Mellon Institute, Pittsburgh, Pa.

which will give us precise information concerning proximate or ultimate constitution of the solution or suspension that is the waste, that is, either concentrations of elements, ions, or specific information as to the nature of the larger, more complex, molecules present. It should be possible to fit these analytical data into tabulations with a minimum of correction. As a simple illustration, when determining acidity or alkalinity of waters, it would be desirable if the results could be related one to the other, as by the use of a single indicator. We do not believe that we are interested in calcium or magnesium as producers of hardness or of scale, but as alkaline earth metals themselves. The industrial effects of these elements are calculable from the ultimate composition; to calculate in the opposite direction requires assumptions which may embrace occasional fallacies.

It has been announced that Committee D-19 is concerned only with waterborne wastes between the intake and the outfall, and in no way is going to concern itself with waste treatments or by-product recovery. But we must not lose sight of the fact that the data provided by the coordinated methods we hope to develop determine to a large extent the subsequent fate of those wastes. The availability of water is of tremendous importance to industry. Even though water is at hand in river, lake, or spring it must be pumped and, too many times, purified in one way or another. Important ways to industrial economy are care in the use of water, or the clarification, and reuse of water. Consequently, the committee ought to pay attention to the means of obtaining the data that will aid in the development of recovery systems as well as to the determination of the suitability of the wastes for discharge from the plant.

Most of the problems in waste disposal have to do with wastes of organic composition and whose decomposition in purification processes, whether natural or accelerated, is by biological oxidation. Consequently, the principal criteria of these wastes are their oxygen saturation and their oxygen demand. Although there seems to be general acceptance of present standard methods for these purposes by sanitary chemists, these methods may lead to misunderstandings regarding the quality of waters and wastes. It is our opinion that the determination of oxygen demand and what actually constitutes oxygen demand require a new agreement regarding standard procedure.

There has always been a feeling among analysts, especially commercial analysts, that a desirable analytical procedure was one that was indicative of the commercial performance of the commodity analyzed. Fire assay of precious ores is not as precise an analytical procedure as electrolytic determination of the metals from carefully prepared solutions. But fire assay is melting in miniature, and consequently gives a pretty good approximation of what might be expected in commercial smelting. Chandler's clever devising of the assay ton, a factor weight representing, in milligrams, the number of troy ounces in an avoirdupois ton, made the assay process still easier to comprehend. Many of the earlier-devised assay procedures for alkaloid-containing drugs were used because, in miniature, they reproduced the commercial extraction process and gave a close approximation of the yields that might be expected. Refinements in these several types of assay methods, often involving a departure in principle, were apt to be disappointing because they then brought to view inefficiencies in the commercial manufacturing methods.

Originally oxygen demand was determined by strictly chemical means involving the measure of the consumption of standardized oxidizing agents. Because of the varying resistance of contaminants to oxidation, and, likewise, the sensitivity of the oxidizing agents to spontaneous decomposition, research resulted in development of biological assays that were presumed to parallel and perhaps duplicate natural processes of water purification. As with many other analytical methods, it was found necessary to make assumptions and corrections. In order to secure uniformity of biological activity, dilution, often quite extensive, was resorted to, accessory nutrient salts occasionally added, and attempts made to correct the inorganic composition of the sample if it was thought capable of interference. Such procedures, then are expected to indicate what may occur on large-scale waste disposal by natural processes. In justice to those who rely on the method it must be said that for the study of purely domestic contaminations the data obtained are quite significant. To one accustomed to other carefully standardized procedures for biological assay, the lack of either a standardized culture or a suitable reference standard for determining the potency of the seeding appears to be a serious fault.

We have already pointed out the great diversity of substances found in industrial wastes. Some, such as acids of alkalies, are merely bacteriostats or coagulants for some of the waste materials. Others are actually bactericidal. They interfere with biological oxidations in the laboratory and they interfere with the same oxidations in nature. But while the laboratory represents a static condition the stream is dynamic and in its flow meets neutralizing waters, and diluting waters. Eventually, having overcome bacteriostasis and other protective processes, it meets fresh inoculation and decomposition begins anew. Any standardization of procedure that will strike through to the determination of the significant load will greatly advance the whole field of industrial waste control.

What, then, shall we look for in our standard methods in order that we may have proper cooperation between our plant chemists, our operating personal, and our sanitary engineers? First there should be an agreement as to the scope of any proposed method.

Secondly, there should be agreement not only as to scope, but also as to theory of a determination. Quantitative and qualitative tests must have significance; they must be definitely indicative of some particular condition.

Thirdly, every procedure used must be capable of duplication as to result, and more important still, must be capable of verification as to significance by the use of a reference standard under the full conditions of the test.

Fourthly, when agreement is reached concerning the procedure to use, agreement must be reached in every detail. These details must be so described that nothing will be left to the imagination of the analyst. We cannot accept the dictum of a very scholarly research chemist of our acquaintance that it is wrong to require a scientist to follow a standard method because that stifles his initiative.

Fifthly, collection, packaging, transportation, and storage of samples must be so clearly prescribed as to insure to any analyst that he is dealing with an authentic sample that represents actual conditions at the time and place of sampling.

Sixthly, scrupulous attention must be given to devising systems of calculation and reporting of data in order that those data may be intelligible to any other person skilled in the art.

We may hope that the experience already gained by workers in the field may stand the committee in good stead, and the activities of the committee will serve to coordinate procedures to be used.

[See Joint Discussion, p. 43.–Ed.]

Gaging and Sampling Water-Borne Industrial Wastes

By Charles F. Hauck[1]

IN SELF-INTEREST, and sometimes in self-defense, industry must know what substances enter, pass through, and are discharged from its plants by the water route. Such data can be obtained by gaging, sampling, and analyzing water streams flowing within industrial plants. Such data are virtually essential to a prediagnostic examination of industrial plants suffering from "pollutionitis."

Discussion of the diagnostics and therapeutics of pollution problems is beyond the scope of this paper. Rather we will consider the various factors which must be considered in measuring and sampling water-borne wastes. The stream under surveillance may be an intermittent discharge from one operation or a continuous complex composite from an entire plant in any industry. Obviously the formulation of detailed sampling procedures for the multifarious sampling conditions and purposes which are encountered in industry is impractical. Instead we wish to discuss the many factors which must be considered in one or a series of samplings and gagings. The judgment, knowledge, and resourcefulness of the sampling program planner must be relied upon to evaluate properly these factors for a particular investigation. Sampling water-borne wastes involves, we shall see, a thorough knowledge of hydraulics, statistics, and familiarity with the physical and operational characteristics of the plant involved.

The Essence of a Good Sample:

By definition, a sample is "A part of anything presented for inspection or shown as evidence of the quality of the whole—a specimen."

To say that a sample is good is to state that it is representative. It is representative when it is similar in every essential characteristic to the stream from which it is taken. It is important that this likeness be preserved until examination of the sample is completed.

Probably the first regular sampling routine known to man was tasting vegetation and wild life. Indubitably it was quickly evident to our forebears that the stew should be stirred before it was tasted. Thus, at the very dawn of man's reason he realized that representativeness is the very essence of a good sample.

To obtain a representative sample, we must consider these questions:

1. Is the sample intended to reflect average or spot conditions?
2. Does the volume and composition of the waste water fluctuate widely or not?
3. Are such variations in composition periodic or random?
4. Where in the waste-water flow route should the sample be obtained?
5. Is the waste water homogeneous at the sampling point?
6. How long should the sample lines be purged before the sample is taken?
7. Is it necessary to preserve the sample and how can this be accomplished?
8. How much sample will be needed to make the analyses desired?

Importance of Good Sampling:

Too frequently gross sampling errors vitiate the results of arduous analytical procedures carried out to obtain high accuracy in examining industrial waste waters. Too often we concentrate our efforts on reducing errors in analysis from 0.2 to 0.15 per cent while blithely ignoring errors of 10 to 20 per cent in sample collection.

This striving for accuracy to the right of the decimal point, while at the same time ignoring or assuming accuracy to the left of the decimal point, may be likened to the mediocre golfer who hopes to break a hundred through long hours of practice with the woods and irons to get a little more distance and better direction on the fairways, but forgets the unimpressive putter which is used more than any other club in the bag.

Gross sampling errors frequently are associated with determination of substances having specific gravities decidedly different than water. For example, light oils will concentrate near the surface of a stream and inorganic precipitates will tend to collect on the bottom, making it difficult if not impossible to collect a sample containing these substances in the same proportions in which they are present in the stream. Extreme care should be exercised in sample collection under these difficult conditions, so that sampling errors will be minimal.

Sampling errors may result from how the sample is taken, where it is collected, or the method of compositing. Such errors may be cumulative or compensating. Too frequently, due to hidden sampling errors, false conclusions are derived about the efficiences of waste-producing or waste-treating operations.

Shall the Sample Be Spot or Composite?

The patterns of flow and concentration variations of the stream under surveillance and the precise purpose of sampling largely determine whether spot or composite samples should be collected. If the samples are intended to yield data on the total quantities of one or more waste water components, a composite sample will be satisfactory. On the other hand, if sampling is being done to establish the shape and amplitude of concentration fluctuations, a series of catch samples is necessary.

Composite samples collected for periods of one to twenty-four hours are usual. But when a waste water stream carries, at various times, substances which interact with each other, such as oxidizing and reducing agents, acids and bases, hot and cold water, compositing may blot out the real characteristics of the waste water. For example, a textile finishing plant discharges strongly alkaline waste waters for the first hour or two every day and acid waste during the remainder of the day. Although the pH of hourly composite samples made up of catch samples collected at fifteen-minute intervals ranged from 11.2 to 3.5, a 9-hr. composite had a pH of 7.8. Thus, compositing concealed the high and low pH values of the mill's effluent which occurred at various times.

Sometimes the effort required to get the necessary data by composite sampling is greater than the work involved in getting equivalent data from a series of catch samples. Furthermore, for some purposes, such as chlorine residual, chlorine demand, dissolved oxygen determination, and bacteriological examination, composite samples are not satisfactory. Catch or grab samples give a snapshot picture of things as compared with the average picture obtained through composite sampling. When concentration variations in water-borne waste are inconsequential or gradual, catch samples reflect average as well as momentary conditions.

[1] Hall Laboratories, Inc., Pittsburgh, Pa.

When the characteristics of a waste water fluctuate widely and frequently, the volume is not excessively large, and a composite sample is satisfactory, it is occasionally simpler to impound the waste water and collect a homogeneous sample of the mixed flow.

In all instances the sample origin, method of collection, the type and rate of operations during the sampling period should be part of its identification. Unless all pertinent data are recorded, full interpretation of analytical results may not be possible.

Sampling and Statistics:

The average characteristics of a plant's water-borne wastes may sometimes be more easily and accurately defined by applying statistical measures to a series of grab-sample results than from composite samples. Merely averaging grab-sample results usually has little significance or validity, due to the variability of industrial waste waters.

The shortcomings of arithmetic averages in defining sewage quality and sewage plant performance was discussed by Keefer (1)[2] as early as 1924, and more fully by Larson (2) in 1932. Since then there has been a definite trend toward statistical treatment of data on water quality and water treatment plant performance. Flower, Budd, and Hauck (3) pointed out the importance of sampling and the advisability of using median values and weighted averages to establish sedimentation efficiencies and solids balances for sewage plants.

Such statistical interpretation of analytical data greatly enhances its value and dependability. The mean, commonly known as the average, the median, and mode are all measures of central tendency. The median is the middle value of an array of data arranged in the order of increasing magnitude. The mode is the most frequently occurring value in a series of values presented in a frequency distribution. In water purification the term M.P.N. (Most Probable Number) is well known. This is a statistical expression of the bacterial quality of a water sample. It is the modal or most probable bacterial count which would produce the results observed by bacteriological examination of the sample.

Definition of water-borne industrial waste composition in terms of median, mode, mean, standard deviation, probable error, confidence levels, etc., is more useful and reliable than mere reporting of individual or average results. Although this statistical interpretation of data has more bearing on the presentation and evaluation of analytical results than it does on sampling, it is, nevertheless, always helpful and occasionally essential in planning a sampling program. On this subject the reader will find the Symposium on Usefulness and Limitations of Samples which appeared in 1948 of the Society's *Proceedings*,[3] worth reading, not only for the views presented therein but also for the many good references cited.

Where Should Samples Be Collected?

Selection of a satisfactory sampling point is also of great importance in procuring a water specimen typical of the waste-water stream being surveyed. What happens stepwise in plant processes and its bearing on the purpose of sampling are important. If various branch lines contribute substances which affect each other, such as acids and alkalies, a sample from the main stream will only reflect the net effect of these substances. Choice of sampling location is even more important when the profiles of composition changes are being sought. In such instances, especially when catch samples are collected, the timing of sampling at several points in the manufacturing process must be carefully synchronized. Finally, the point selected for sampling must be desirable from the standpoint of hydraulic suitability. In general, points of great turbulence in the stream being sampled are desirable. Therefore where gaging and sampling are done, usually it is better to sample just below a weir, orifice, nozzle, etc. In fact, for sampling we prefer hydraulic conditions perfectly nonideal for solids separation. At the point of sampling the velocity should at least be sufficient to transport the heaviest material present. Merriman (4) has shown that the transporting capacity of water varies as the sixth power of its velocity. Thus doubling the velocity increases transporting capacity sixty-four times. Therefore, since the velocity of flow near the perimeter of a conduit or channel is roughly one-half the center velocity, the transporting power of water moving near the walls of a conduit or channel is only one sixty-fourth as great as at the center. This relationship explains in many instances the accumulation of solids along the bottom of large pipes and channels.

Figure 1 illustrates the tremendous effect of solid size and specific gravity upon settling behavior. In order to get an ideally representative sample, velocity in the conduit must be sufficiently great to keep the largest solids in suspension. When this condition does not exist, the point where sedimentation is least likely to occur should be selected.

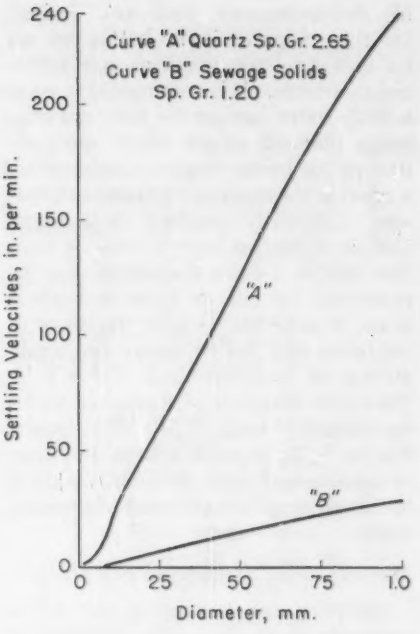


Fig. 1.—Relative Settling Velocities of Organic and Inorganic Solids at 50 F.

E. E. Seelye, "Data Book for Civil Engineers," *Design*, Vol. I, pp. 5–44.

The Metropolitan Sewage Commission of New York (5) found that a minimum of 0.25 ft. per sec. was necessary to move fine clay and silt along channel bottoms. Bazalgette (5) also determined the velocities required to move various substances along the bottom of a channel. For fine clay he found 0.25 ft. per sec. was needed, for sand 0.5 ft. per sec., for coarse sand 0.66 ft. per sec., for fine gravel 1.0 ft. per sec., for pebbles 1 in. in diameter 2.00 ft. per sec., and stones of egg size 3.00 ft. per sec. A mean velocity of 2.5 ft. per sec. will generally prevent deposits in combined sewers (storm and sanitary) and a velocity of 2 ft. per sec. will ordinarily prevent deposits in sanitary sewers. A mean velocity high enough to prevent sewer deposits is referred to as a self-cleaning velocity.

Such velocities, however, are not always sufficient to assure homogeneity of the water-borne waste. Dissolved substances such as acids, bases, brines, dyes, etc., travel for great distances as slugs or cylinders in large pipes or channels without blending with the surrounding water. Stratification of dissolved solids, flotation or sedimentation of suspended solids can be eliminated by turbulent velocities, mechanical or air agitation at the sampling point.

Sample Size:

Care must be exercised so that the sample is large enough to make

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

[3] *Proceedings*, Am. Soc. Testing Mats., Vol. 48, pp. 857–894 (1948).

all determinations that are desired. In this respect, it is better to err by collecting too much sample rather than too little. It is not unusual to want a little extra sample for tests not originally planned or for check analyses. Except for bacteriological examination, a quart is the minimum practical sample size. Generally speaking, it is advisable to collect at least a two- or four-liter sample. When the sample must be preserved for one or more determinations, it is better to take duplicate or triplicate samples to insure the availability of complete data. A.S.T.M. Tentative Methods of Sampling Water for Industrial Uses (D 510–47 T)[4] specifies the volumes needed to make many of the determinations frequently wanted in analyzing water-borne industrial wastes.

Manual versus Mechanical Sampling:

Sampling can be carried out either manually or mechanically. Mechanical collection of samples is usually combined with flow measurement. The simplest method of sampling by hand is to dip or scoop a portion of the liquid to be sampled from the center of the stream. This is a laborious and undependable procedure. Under such circumstances sampling accuracy is greatly affected by the human element.

Manual or hand sampling may involve simple or complex procedures, and apparatus, ranging from casually scooping a sample to the studied techniques recommended in A.S.T.M. Tentative Method D 510–47 T. At the same time, anything from a broken milk bottle to a carefully fabricated dissolved oxygen sampler has been used for manual sampling. Since the reliability of hand sampling depends almost entirely upon the judgment and care exercised by the sampler, little can be gained from a review of the many hand-sampling contrivances and methods which have been proposed. Contrariwise, mechanical sampling practically eliminates the influence of the human factor after the samplers have been properly installed. The most common shortcoming of automatic samplers is their failure to collect the sample across the entire cross-section of flow. Whenever sampling is to be continued over a long period of time, the cost of automatic sampling equipment can be easily justified on the basis of lower cost and higher accuracy. For these reasons automatic mechanical sampling is growing more popular.

Automatic samplers can be classified in several ways. For example, some samplers such as the Trebler Unit collect a sample of variable size proportional to flow at fixed intervals. Most of the others such as the Ring Balance Unit, Fig. 2, collect a fixed volume at variable time intervals depending on flow rate. Automatic samplers are essentially made up of two parts, first, the mechanism which actually collects and transports the water from the stream to a container and, second, the mechanism which controls the operation of the sample-collecting device. Automatic sampler may also be classified according to the types of units making up the sampler. Thus the sample portions can be collected and transported to a storage container by a pump (Infilco, Milton-Roy), plunger (DeZurick), scoop (Trebler). The mechanism controlling the sampling device can be a timer (Trebler), water wheel (Montague Brothers), venturi, orifice, Parshall Flume (Ring Balance), etc.

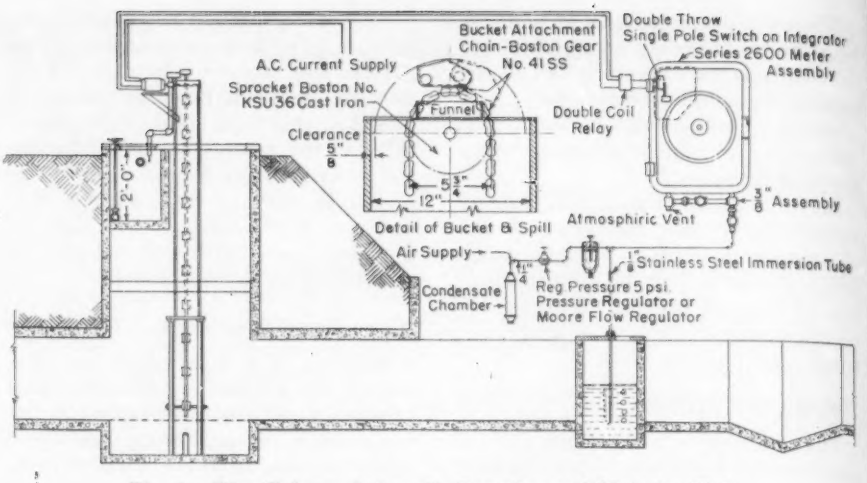
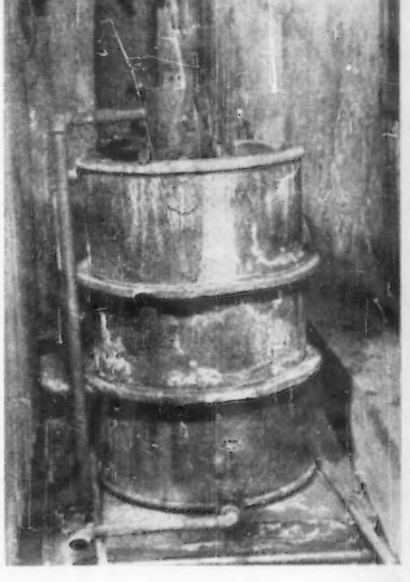


Fig. 2.—Ring Balance Automatic Sampling and Metering Unit.

The Ring Balance sampler illustrated in Fig. 2 indicates, records, and totalizes the flow at the sampling location and collects a constant volume of sample at variable intervals depending on flow rate. The type of primary element used and sample-collecting device employed depends on the characteristics of the water-borne waste and physical conditions at the sampling station. In this particular instance a Parshall Flume is used as the primary element. Variations in flow result in corresponding changes in back pressure in the air probe line mounted in the stilling well. These fluctuations in air pressure are converted into pen movement on the Ring Balance indicating and integrating meter. Every time the meter totalizes a predetermined increment in volume the motor driving the sampling mechanism is energized and a constant volume of sample is delivered by the collecting buckets to the sample reservoir.

The representativeness of a composite sample depends on the representativeness of the individual portions collected and proper compounding of these portions. The accuracy of the individual portions depends upon the physical manipulation involved in their collec-



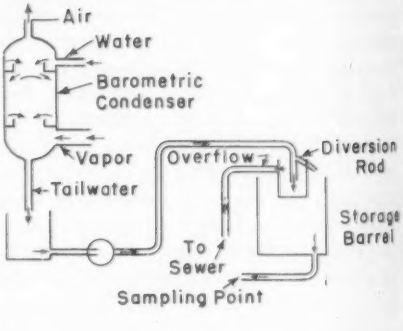


Fig. 3.—Simple Device for Collecting Eight-Hour Composite Samples of Condenser Tailwater.

[4] 1947 Supplement to Book of A.S.T.M. Standards, Part III-A, p. 290.

tion. Obviously, a sample obtained across the entire flow cross-section is much better than one which is dipped or scooped from a restricted area of flow. Ideally, flow should fill the sampler from many points at rates proportional to the flow velocities at these same points. This means that about one-half to two-thirds of the sample volume should come from the center of the channel and the balance from the top and bottom.

Such automatic sampling devices range in cost from $200 to $1000 or more depending on the accuracy and type of metering device employed. Instead of buying a ready-made sampler, many plants design and fabricate their own automatic sampling gadgets. For example, a plant desiring to collect three 8-hr. composite samples of barometric condenser tailwater devised the simple arrangements shown in Fig. 3. A pump delivers tailwater at a constant rate to a waste pipe. A small part of it is then diverted by an inclined rod to a large receiver from which a composite sample is drawn every eight hours. The remaining volume is drained to the sewer. For the special sampling duty it was designed for, this arrangement is wholly adequate and sufficiently accurate.

Similarly at Westinghouse Air Brake Co. the sampling machine shown by Fig. 4 was built to meet special sampling requirements. This will automatically measure waste-water volume, determine pH, and record both values. This equipment is moved from place to place in the plant to collect detailed data on about a hundred processing operations.

There are an increasing number of installations which combine continuous sampling with continuous analysis of some characteristics of the water sampled, for example, pH, conductivity, turbidity, etc. Many such arrangements are being used to neutralize automatically alkaline or acid wastes. These setups usually include recording and controlling functions as well as automatic sampling and analysis. It is very likely that this trend toward automatic sampling, analysis, and control will be accelerated in the future.

When and How Should Waste Water Flow Be Measured?

Measurement of water flows within and leaving industrial plants may be necessary for one or more of the following reasons:

1. In order to gage variable flows so that a representative composite sample can be obtained.
2. For computing material balances between points within the plant.
3. To obtain essential information for the design of industrial waste abatement or treatment facilities.

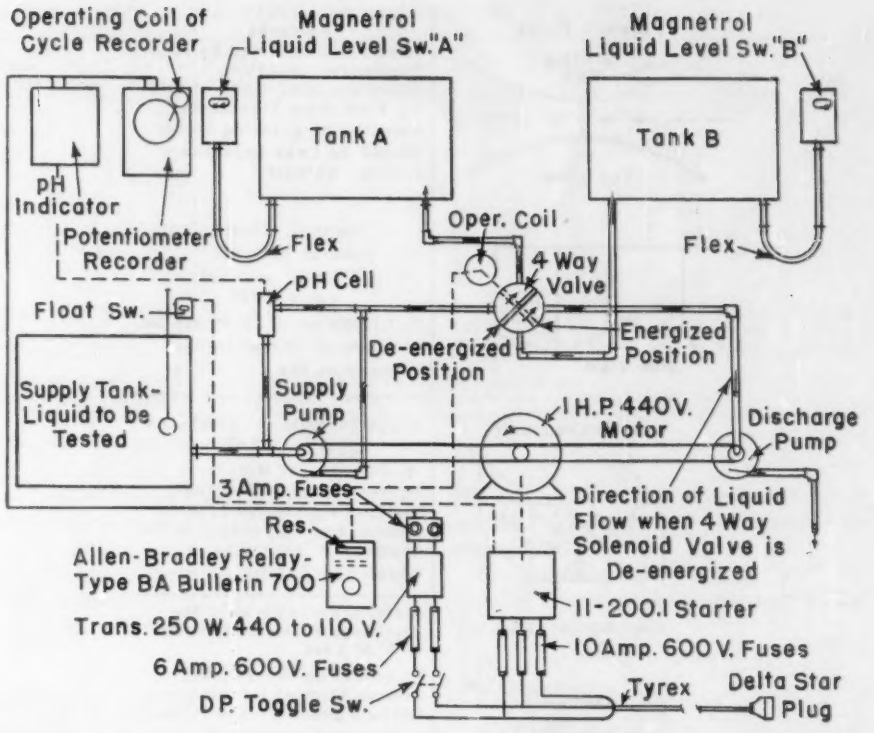
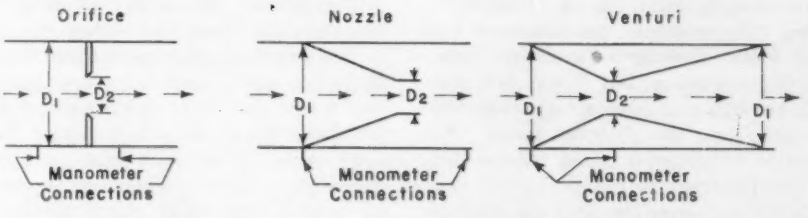


Fig. 4.—Apparatus Built by Westinghouse Air Brake to Obtain pH and Volume Data on Water-Borne Wastes.

The waste analyzer functions as follows: When tanks *A* and *B* are empty, the contacts of the Magnetrol liquid level switches are open. Closing the control switch starts the motor. The supply pump discharges through the four-way valve into supply tank *A*. A small part of the liquid is by-passed through the pH cell and returned to the pump. As it passes through the cell the pH value is recorded on the chart. When the liquid level in tank *A* has reached a height determined by the Magnetrol liquid level switch *A* setting, a mercury switch is closed energizing a relay which causes a four-way solenoid valve to operate. Valve ports are thus set to discharge water from tank *A* through discharge pump to sewer or back to process. The supply pump then fills tank *B*. When Magnetrol switch *B* is tripped the four-way valve is de-energized and the cycle repeated.

Contacts on mercury switches *A* and *B* also operate a cycle recorder thus leaving a small mark on the edge of the pH chart for use in determining the quantity of a liquid flowing from a process over a given period of time.

We are indebted to Mr. W. K. Aites, Assistant Chief Chemist of the Westinghouse Air Brake Co. for the diagram and its explanation.



General Formula for Flow Through Orifice Nozzle and Venturi Meters

$$Q = CKD_2\sqrt{h_1 - h_2} \qquad \text{Where } K = \frac{\pi}{4}\sqrt{\frac{2G}{1-\left[\frac{D_2}{D_1}\right]^4}}$$

Q - Flow Rate C - Friction Coefficient
$h_1 - h_2$ Static Head Differential
D_1 - Diameter of Conduit
D_2 - Diameter of Metering Device
G - Acceleration Due to Gravity

	Orifice	Nozzle	Venturi
Cost	Inexpensive to Install	Installation Cost Lies Between that of the Orifice and Venturi	Expensive to Install
Accuracy	Due to "Vena Contracta" the Downstream Pressure Measurement is Indefinite	Downstream Pressure Measurement is Definite	Downstream Pressure Measurement is Definite Very Accurate
Friction Coefficient	Ranges from 0.50-0.70	Ranges from 0.98-1.01	Ranges from 0.98-1.01
Energy Losses	With $\left[\frac{D_2}{D_1}\right]^2$ Ranging from 0.20-0.70, the Per Cent Pressure Recovery is from 22-68 Per Cent Respectively	Pressure Recovery Exceeds that of the Orifice but is Less than that of the Venturi	With $\left[\frac{D_2}{D_1}\right]^2$ Ranging from 0.20-0.70, the Per Cent Pressure Recovery is from 82-90 Per Cent Respectively

Fig. 5.—Metering Devices for Pipes Flowing Full.

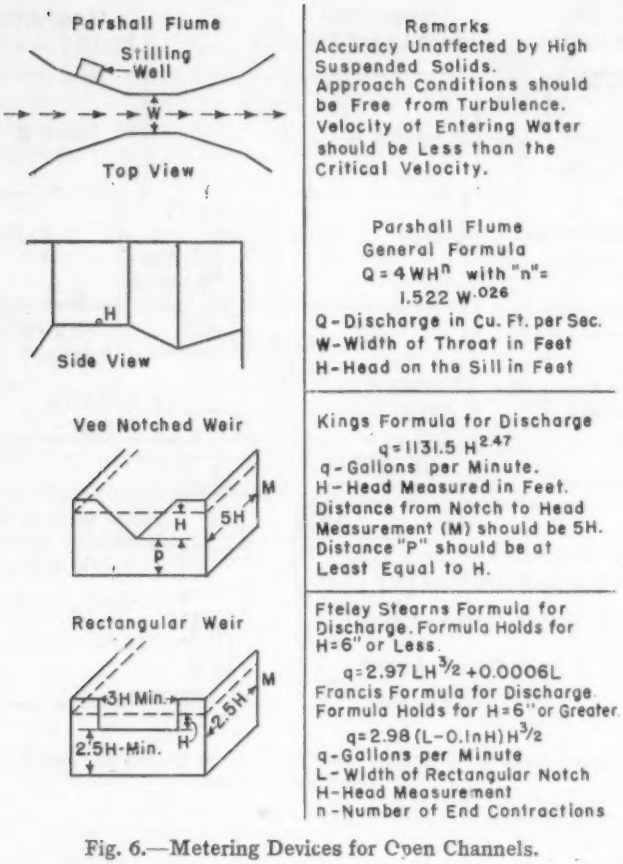

Parshall Flume
Stilling Well
W
Top View
H
Side View
Remarks
Accuracy Unaffected by High Suspended Solids.
Approach Conditions should be Free from Turbulence.
Velocity of Entering Water should be Less than the Critical Velocity.
Parshall Flume
General Formula
Q = 4WH^n with "n" = 1.522 W^-.026
Q - Discharge in Cu. Ft. per Sec.
W - Width of Throat in Feet
H - Head on the Sill in Feet
Vee Notched Weir
H
5H
M
P
Kings Formula for Discharge
q = 1131.5 H^2.47
q - Gallons per Minute.
H - Head Measured in Feet.
Distance from Notch to Head Measurement (M) should be 5H.
Distance "P" should be at Least Equal to H.
Rectangular Weir
3H Min.
2.5H Min.
H
2.5H
M
Fteley Stearns Formula for Discharge. Formula Holds for H=6" or Less.
q = 2.97 LH^3/2 + 0.0006L
Francis Formula for Discharge. Formula Holds for H=6" or Greater.
q = 2.98 (L - 0.1nH) H^3/2
q - Gallons per Minute
L - Width of Rectangular Notch
H - Head Measurement
n - Number of End Contractions

Fig. 6.—Metering Devices for Open Channels.

Extreme care and a critical attitude must be exercised in gaging waste-water flows. For example, we measured the rinse water flowing to a stream from pickling operation, but it was not possible to obtain an approximate chemical balance using the observed flows. An attempt to obtain a liquid balance led to the discovery of major sewer leaks. Only through cross checking can reliable data on water-borne industrial wastes be obtained.

Flows can be measured by direct means, such as an orifice, nozzle, weir, etc., or indirectly by calculation from the time a pump operates, the time required to drain or fill a vessel, etc.

The flow measurement devices commonly used are illustrated in Figs. 5 and 6. Special care must be used in employing weir formulas, since they are empirical and therefore accurate only within restricted limits depending on the conditions of the original studies from which they were developed. Thus, the Francis formula will yield reliable results only for low heads between 0.4 and 1.6 ft. Selection of a metering device for a specific job depends on local conditions, the length of time gaging will continue, the degree of accuracy required, the variability of flow, etc.

Besides the measuring devices shown in Figs. 5 and 6, there are other unusual but useful gaging methods such as the parabolic flume, Kennizon nozzle, current meter, California pipe and salt velocity methods. The current meter as used in industrial plants would be mounted on a rod projecting into the waste-water stream. The cup-type meters revolve on an axis due to the pressure differential between the concave and convex sides. The propeller type meters are driven by vanes on a horizontal axis and turned by the current action. Ordinarily current meters do not fit plant-flow measurement requirements.

A closed can, stick, ping-pong ball, etc., may be used to determine stream velocities. If the float is placed at the center of the stream the velocity observed would be about 1.17 times the average velocity over the entire cross-section of flow. Actually the exact relationship between surface velocity and mean velocity depends on several factors and conditions. Subsurface floats have also been used for determination of stream velocity.

Flow rates in filled pipes and conduits of uniform cross-sectional area may be computed by multiplying the cross-sectional area and the mean velocity. If the conduit is irregular in size its total volume must be calculated to determine the rate of flow. The pipe volume divided by the time of travel yields the discharge rate.

Mean velocities may be computed by either the color or salt velocity methods. The former method uses fluorescine, Congo red, or potassium permanganate to color the water being gaged. The time elapsed between introduction of the color into the stream and the mid-moment between the initial and final showing of color at the downstream observation station is observed. This average travel time is then converted into mean velocity. The salt velocity method (6) is similar in principle to the color procedure.

Protection of a Sample's "Representativeness":

Equal in importance to collection of a good sample is the preservation of its representativeness between the time of sampling and analysis. The pollsters attribute their notorious failure in predicting the outcome of the last election to the unrepresentativeness of their sampling caused by the time factor.

Waste-water samples may be unstable due to their chemical, physical, or biological characteristics. Concentrations of cyanide, phenol, hydrogen sulfide, dissolved oxygen, etc., change rather rapidly. Likewise, easily oxidized or reduced substances, temperature, and color are susceptible to rapid change. Solids frequently tend, depending on conditions, to coagulate or peptize, thus affecting the suspended solids value. Bacterial and microorganism counts in water samples are notably "unfixed." Water-borne wastes carrying nutrient organics such as dissolved carbohydrates and proteins will be affected quickly by biological activity. Although the instability of industrial waste samples is generally realized, present knowledge of stability limits is far from satisfactory.

Obviously the best insurance against sample change is prompt analysis. Since this is seldom practical, other antidotes for change are employed. The most common means of minimizing changes in sample composition between the time of collection and analysis is refrigeration. Maintaining the sample at 6 to 10 C. represses the volatilization of dissolved gases, for example, oxygens, hydrogen sulfide, etc., and retards biological ac-

TABLE I.—PRESERVATIVES FOR WATER-BORNE WASTE SAMPLES. VALUES TO BE FIXED.

Preservatives	Biochemical Oxygen Demand	Suspended Solids	Relative Stability	Oxygen Consumed	Dissolved Oxygen	Nitrogen Balance	Phenol	Total Sulfide	Sludge	Mud	Chlorinated Waters	Cyanide	Total Solids
Sodium Thiosulfate	..	..	..	..	..	..	..	..	..	..	X[d]	..	..
Sodium Benzoate	..	..	..	..	..	..	..	..	..	X[d]	..	..	..
Refrigeration	X[a]	X[a]	X[a]	X[a]	X[a]	X[a]	..	..	X[d]	X[d]	..	..	X[d]
Sodium azide	..	..	..	..	X[a]	..	..	..	..	..	..	..	..
Sulfuric acid	..	..	..	..	X[a]	X[a]	..	..	..	X[d]	..	..	..
Zinc acetate	..	..	..	..	..	..	..	X[a]	..	..	..	..	..
Copper sulfate	..	..	..	..	..	..	X[a]	..	..	..	..	..	..
Sulfamic acid	..	..	..	..	..	..	X[c]	..	..	..	..	X	..
Add NaOH to pH 7.5–8.5	..	..	..	..	..	X[a]	..	..	..	..	..	..	..
pH to 1.5	..	..	..	X[a]	..	..	..	..	..	..	..	..	..
Chloroform	..	..	..	..	..	..	..	..	X[d]	..	..	..	..
Formalin	..	..	..	..	..	..	..	..	..	..	..	..	..
Time limit before fixation	6–12 hr.	6–12 hr.	6–12 hr.	6–12 hr.	1–2 hr.	6–12 hr.	4 hr.	1–2 hr.	7 days	7 days	1–2 hr.	1–2 hr.	6–12 hr.
Time limit after fixation	Not known	Not known	Not known	Not known	24 hr.	Not known	Few days	Not known	Not known	Not known	12 hr.	Not known	Not known

[a] "Standards Methods for the Examination of Water and Sewage," Ninth Edition, American Public Health Association.
[b] Kenneth W. Brown, "Selection and Control of Sampling Points in Distribution Systems," *Journal*, Am. Water Works Assn., Vol. 39, Part II.
[c] M. B. Ettinger, S. Schott, and C. Ruchhoft, "Preservation of Phenol Content in Polluted River Water Samples Previous to Analysis," *Journal*, Am. Water Works Assn. J., Vol. 35, Part I.
[d] Metcalf, Leonard, and Eddy, "American Sewerage Practice," Vol. III.

tivity which affects both the chemical and physical characteristics of the samples. Hatfield has shown that biological oxygen demand values decrease unless the sample is maintained at 4 C. or less.

Mr. Braley, Secretary of Subcommittee VII, A.S.T.M. Committee D-19, heads an investigation of how acid mine water is formed. This research is being conducted at Mellon Institute for the Commonwealth of Pennsylvania. Mr. Braley reports that the instability of the mine-water samples is striking. For instance, perfectly clear samples tightly stoppered have produced substantial sediment within 24 hr., indicating oxidation of ferrous iron to the ferric state. Yet 8 or 9 ppm of oxygen has been found in samples containing as much as 2000 p.p.m. of ferrous iron. Even stranger results are obtained in determining pH on acid mine and other waste waters. The influence of delays between sampling and examination of samples for biological, particularly bacteriological, data has been more fully investigated than any other phase of sample stability. Nevertheless, according to Miss K. E. Cox (7) there persists a diversity of opinion regarding storage of bacteriological samples. Miss Cox found that unrefrigerated samples were "not too bad" if planted within 48 hr. and that they were satisfactory for longer periods if refrigerated.

Table I summarizes in a qualitative manner recommended methods of "fixing" water-borne industrial wastes. Inspection of the table reveals the gaps and uncertainty of the data on preservation methods.

Summary

From the foregoing discussion it is evident that data on water-borne industrial wastes are apt to be erroneous unless care and judgment are exercised in sample collection and preservation.

A sound sampling and gaging program aimed at reducing or treating water-borne industrial wastes can be planned only after full consideration of these points:

1. The purpose of the gaging and sampling program.
2. The nature of the plant or process operations affecting sample composition and volume.
3. Selection of sample type to give reliable results with a minimum of work.
4. Scheduling sample collection to reflect the full range of operating conditions under study.
5. Choice of a sampling point and procedure which will assure collection of a truly representative sample of adequate size.
6. Advisability of making flow observations during sampling.
7. Samples should be promptly delivered from the field to the laboratory for analysis or its representativeness should be preserved by refrigeration or chemically.
8. Necessity for noting and recording operating conditions during the sampling period.

Acknowledgment:

The author wishes to express his appreciation to Miss B. Work, Mr. C. E. Kaufman, and Mr. D. Harrod of Hall Laboratories staff for their assistance in preparation of this paper.

References

(1) C. E. Keefer, "Operating Results of Baltimore Sewage Works, 1919–1922," *Engineering News-Record*, Vol. 92, p. 250 (1924).
(2) C. C. Larson, "Suggestions for Increasing the Value of Sewage Treatment Works Data," *Sewage Works Journal*, Vol. 4, p. 101 (1932).
(3) G. E. Flower, C. B. Budd, and C. F. Hauck, "Solids Balancing," *Sewage Works Journal*, Vol. 11, p. 480 (1939).
(4) Merriman, "Hydraulics," 9th Edition, p. 340.
(5) L. Metcalf and H. P. Eddy, "American Sewerage Practice," Vol. 1, Design of Sewers (1928).
(6) Allan-Taylor, "The Salt Velocity Method of Water Measurement," *Transactions*, Am. Soc. Mechanical Engrs., Vol. 86 (1923).
(7) K. E. Cox, "Effect of Time and Temperature of Water Samples Prior to Bacteriological Examination," *Water and Sewage Works*, Vol. 95, pp. 445–446, December, 1948.

JOINT DISCUSSION

Mr. Harold Hughes.[1]—Messrs. Beal and Braley have referred to bactericidal material. I wonder whether phenol in a stream is always undesirable since it is an antiseptic.

Mr. S. A. Braley (*author*).—I should like to refer to Mr. Hodge of Mellon Institute, any question relative to phenol since he is working on phenol and is better qualified to discuss phenol than I.

In so far as antiseptics are concerned it is just as detrimental to add antiseptic wastes to a stream as those which are not antiseptic. Phenol in itself is a compound which, through normal processes of water treatment, especially chlorination, produces extreme odor and taste.

There is one point in this connection which is important: namely, analytical procedure and standards. Some states

[1] Socony-Vacuum Laboratories, Brooklyn, N. Y.

permit zero addition of phenol while some others permit a limit on a pounds-per-day basis depending upon the receiving stream but these standards are dependent upon the method of analysis. Standard methods of analysis is the aim of Subcommittee VII.

MR. W. W. HODGE.[2]—The agitation for reduction of phenol in streams started along about 1922–1923, largely because of the disagreeable taste it produced in municipal water supplies, especially after the water supplies were chlorinated. It has been stated that some persons can notice the phenol taste in concentrations as low as 0.1 ppm (parts per million), and the characteristic medicinal taste of certain chlorophenols may be detected in dilution as great as 0.02 ppm.

The rapid development of the by-product coal coking industry shortly preceding and during the first World War resulted in a large increase in the phenol-containing waste liquors discharged to adjacent water bodies. This was especially true of the Ohio River and some of its tributaries, with resulting large increases in the number of complaints of the unpleasant tastes and odors in many water supplies. The need for interstate cooperation to reduce stream pollution was recognized, and by 1928 the Health Department officials of eleven states located in the Ohio River basin and adjacent thereto had formed an informal interstate agreement for the control of water pollution, especially that caused by phenols. The impetus generated by this agreement and the other factors mentioned resulted in the installation from 1927 to 1934 of nineteen dephenolizers, most of them at by-product coke works, which were usually associated with iron and steel plants. Some of the dephenolizers were of the benzol countercurrent extraction type, but most of them were Koppers Vapor-Phase installations. These dephenolizers recovered from 90 to 96 per cent of the phenols in the waste liquors before they were discharged to the receiving waterways. This resulted in marked improvement in many municipal water supplies. One example is as follows: Because of the bad tastes and odors in the Morgantown, W. Va., water supply in 1920–1925, I made the first stream pollution survey in that state. This municipal water supply was obtained largely from the Monongahela River. We took samples of every stream of waste liquor being discharged into the river between the intake of the Morgantown water works and through the City of Fairmont, W. Va., situated twenty-odd miles upstream. By means of a tasting squad we traced the cause of the disagreeable taste to the effluent from a by-product coke plant, located about 20 miles upstream. As soon as this was discovered, the by-product coke company started investigations on methods for removing the phenol from the waste liquors and constructed one of the first dephenolizers built in this country. This dephenolizer started operations in January, 1927. Since then, there very seldom have been any unpleasant odors or tastes in the Morgantown water supply.

Since the end of the recent World War, there have been increasing demands for still further reductions in the amounts of phenol discharged to water ways, especially those which are used as sources of city water supplies farther downstream. The Water Control Board of one state has ruled that no phenol may be discharged to the streams, other state boards have issued orders greatly reducing the quantities of phenol which different plants are allowed to discharge to the waterways. These actions have led to research for a post-dephenolization process to reduce, or eliminate if possible, the comparatively small amounts of phenol remaining in the dephenolizer effluents from by-product coking and city gas works and from factories manufacturing certain kinds of plastics. The efforts of two of the Koppers Co.'s Fellowships at Mellon Institute of Industrial Research are largely directed toward developing a satisfactory post-dephenolization process.

An outstanding development in the treatment of phenol-containing liquid wastes from a large chemical manufacturing plant is the wastes-treatment plant of the Dow Chemical Co., near Midland, Mich., where two biological processes are applied which destroy nearly all the phenols, as well as some other organic substances, and greatly reduce the biochemical oxygen demand (B.O.D.) of the waste liquors. The construction and operation of this plant has been described by I. F. Harlow and T. J. Powers. I recall some of the information given regarding the sections of the plant where the phenolic wastes are treated. The suspended solids in the strong phenolic and other organic waste liquors are largely removed in a 45,000,000-gal. storage pond. The clarified effluent is diluted with weak waste liquor until the phenol content of the mixture is between 30 to 50 ppm., and the pH is adjusted to between 6.1 and 7.5, usually by addition of lime. The light oils are skimmed off, and precipitated solids are removed in a clarifier. This diluted, neutralized, and clarified liquid waste is fed to four trickling filters in which much of the phenol and some other organic compounds are oxidized. The removals per 1000 cu. ft. of filter vary; for phenol from around ½ to 9 lb.; and for B.O.D. from about 16 to 27 lb. at a feed rate of 10,200,000 gal. per acre per day and at temperatures, respectively, of 56 F. and 83 F. The effluent from these filters, together with any excess weak waste liquors, flows through a grit chamber to the activated sludge plant where almost all of the remaining phenol is destroyed, since it will oxidize about 1700 lb. per day of phenol or 5000 lb. per day of B.O.D. The effluent from the activated sludge plant flows to another large storage pond in which some further oxidation of soluble organic substances takes place, and the biological flocs and other suspended matter separate by sedimentation. The clarified, dephenolized effluent from this last storage pond is discharged to the receiving water course at a carefully regulated rate to obtain the needed dilution, depending on the volume of flow and other stream conditions, so that no phenol or chlorophenol tastes will be noticeable in the downstream city water supplies.

Phenol, commonly known as carbolic acid is a powerful antiseptic. It has to be greatly diluted or it will kill the bacteria and other microorganisms in the trickling filter or activated sludge plants which oxidize and destroy the objectionable organic materials in sewage and in some industrial wastes. During an inspection trip to the Southwest Sewage Treatment Plant in Chicago, Mr. F. W. Mohlman, Director of Laboratories, Sanitary District of Chicago, Ill., told me that if the phenol content in the sewage flowing to that activated sludge plant was kept below 40 ppm. (he preferred that it be not over 30 ppm.), the plant could handle the phenolic wastes right along with the domestic sewage and some other industrial wastes. This is the largest sewage treatment plant in America. Its capacity was rated at 300,000,000 gal. per day at the time of my visit, and construction was well under way to double the size of the plant. Mr. Mohlman informed me that about half the load on this sewage treatment works was due to acceptable industrial wastes; the other half was from the domestic sewage of about one million persons living in that District of Chicago. The plant treats most of the industrial wastes from that District of the City.

The above statements indicate that the phenols and many other partially oxidized organic substances are somewhat different from acid mine drainage or waste pickle liquor. The principal

[2] Senior Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

constituents in the former material, as Mr. Braley has stated, are ferrous sulfate, aluminum sulfate, often with small amounts of the sulfates of calcium, magnesium, manganese, and sodium and sometimes a little sulfuric acid; in the latter material, ferrous sulfate and some sulfuric acid. These are well-oxidized inorganic compounds, but the ferrous sulfate may be readily oxidized to ferric sulfate in neutral or alkaline solutions. We made the 5-day B.O.D. test on a sample of waste pickle liquor and found it to be between 8000 and 9000 ppm. We also determined the ferrous sulfate content and computed the quantity of oxygen required to oxidize it to the ferric condition, and that was between 8000 and 9000 ppm. Therefore this was an ordinary chemical oxidation demand. Phenol, on the other hand, is only slightly oxidized, as shown by its formula, C_6H_5OH. There are 6 carbon atoms which can be oxidized to 6CO or $6CO_2$, and 6 hydrogen atoms which can be oxidized to $3H_2O$, but there is only one oxygen atom available in the molecule itself. The OH group on the aromatic nucleus of phenol offers a ready point of attack for oxidation by the billions of aerobic bacteria and other microorganisms present in the flora of trickling filters and activated sludge plants, and in warm weather in most natural surface waters. Hence, the B.O.D. of phenol if it is in very dilute solutions may be reduced by microbial action, oxidizing the C and H in the phenol molecules. If satisfactory arrangements can be made with a near-by trickling filter or activated sludge sewage treatment plant to handle the effluents from the dephenolizers, this might be the best solution for a post-dephenolization procedure. Research is in progress toward developing a satisfactory bioaeration process and a chemical oxidation process for removing the small amounts of phenol which remain in the effluents from the dephenolizers, and these should further abate stream pollution. In our researches we have found that the B.O.D. method is not a satisfactory "yardstick" for some phenolic and other industrial wastes, also, as Mr. Braley stated, there is serious need for fairly rapid, precise, and otherwise satisfactory methods of analysis for phenols and several other compounds when they are present in very small amounts in industrial wastes or in receiving water courses. These subjects are among the objectives of Subcommittee VII of A.S.T.M. Committee D-19.

MR. W. H. FULWEILER.[3]—In connection with the discussion of the antiseptic effects of phenol, it should be noted that in low concentrations phenol is more likely to act as a stimulant than as an antiseptic.

As is so frequently the case, the question of adequate representative sampling is one of the most difficult problems in this work, especially in connection with preliminary surveys. It frequently happens that the effluents are discharged in several points and the composition and rate of discharge may vary quite widely from hour to hour and from day to day, depending upon the operating schedule in the plant.

Where the sampling is to control operating practice, it is of course possible to install permanent sampling devices that will handle this matter quite simply and accurately, but in survey work such devices are rarely possible and recourse must be had to a large number of individual samples and rate determinations.

This leads naturally to the question of the appropriate size of sample. It would appear that this must depend on existing conditions, especially the daily number of samples that have to be handled. If fifty or sixty samples are taken in a day and must be transported at times distances up to a mile to the laboratory setup, the mere transportation becomes a matter of some concern so that the size of the sample must be reduced to a point where it can be conveniently handled.

In the speaker's experience, subsamples collected in 500-ml. glass-stoppered bottles taken from a bucket main sample have proved to be generally adequate.

MR. C. F. HAUCK (*author*).—I believe that Mr. Fulweiler pointed out that too large a sample can also be a mistake.

I agree that fifty samples a day, five gallons in size involves quite a transportation problem. But I also believe that this is pretty much the exception. That would be my first comment on it.

And I will reiterate—I believe it pays to err, on the side of a large sample. In other words, if we find over estimated sample requirement to be two liters, then I say our samples should be three liters to allow for exigencies.

But I don't recommend that it should be five gallons.

I feel further that even if we double it, and made it four liters, or six liters, the inconvenience that is connected with the movement of that sample is small compared with the effort that would be required to reestablish the sampling conditions, retake a sample and reach the same point in the analysis as had been reached when the first sample ran out.

So I will still stand by my original statement; take plenty of sample but exercise judgment; I hope that too many of us aren't burdened in so doing.

MR. BRALEY.—Before I go into the Conestoga Question, I would like to make a statement to Mr. Fulweiler, and also to Mr. Hauck with reference to sampling.

We start sampling a mine and, because it is a new one, we take plenty of samples—sometimes a gallon, sometimes two gallons, and sometimes five. We may do that once or twice.

Subsection A of Sub 7 is set up to deal with constituents of various wastes. There are cases in which a very large sample is at first necessary until you find out that you need a smaller one. Eventually, in most cases of this type of thing as we do in mine sampling, there are certain constituents which will tell you approximately all that you want to know.

While we started out taking very large samples (anywhere from a gallon to five gallons)—today we take about 3500 cu. ml. which are ample. We are running continuous weekly or monthly samplings of that particular effluent.

Now, these remarks, I think, will answer parts of both of these questions as to size of samples. In other words, the purpose for which the sample is to be used, the question of a fragmentary or complete analysis, or the procedure to determine the gradual or amount of change, or the continuity of an operation all affect the selection of sample size.

Now, one is from the standpoint of very careful consideration of a given operation. The other is a control procedure. I think that Mr. Fulweiler is primarily speaking of more or less of a control procedure or a continuous sampling. And I think Mr. Hauck is speaking primarily of a complete analysis of a situation on a spot basis. Now, those are two things which we have to consider, in my opinion, from entirely different samplings.

Mr. Hebley has asked me to mention the work done by the Philadelphia Academy of Sciences on the Conestoga River.

This report, I think, is completely available. However, it eventually will be included with the work conducted by the Philadelphia Academy of Sciences for the State of Pennsylvania to determine the pollution in streams on a biological basis.

I may give you somewhat of a summation.

In four classifications, we might say clean streams, slightly polluted, moderately polluted, and heavily polluted.

[3] Consulting Chemist, Philadelphia, Pa.

This report is based upon the organisms which the Academy workers found in these various streams.

It happens that the Conestoga River has practically everything in it. There are tributaries which supply clean, clear water and there are others which supply highly polluted water.

Earl Weston whom I know and some others that are associated with him have great admiration for this type of determination of what shall be termed pollution. In other words, the amount of the aquatic life that will live under certain conditions is determined.

Some of you are fishermen and you know that there are certain streams that are very heavily polluted with sewage, in which you get some wonderful catfish. But you don't care to eat them; they live there on sewage.

There are others which will not carry trout or some of the more game fish. Now we can carry that idea on down to where we have the lower forms of life that still flourish in certain types of pollution.

That has been primarily the work which was done and reported by the Philadelphia Academy of Sciences on the Conestoga River. It was merely an attempt, and was an indication also of the quandary in which the Sanitary Water Boards find themselves in attempting to say to any industry what they may put into a stream and what they may not put into a stream.

Those are exactly the things that the governing boards are attempting to be extremely reasonable about on this thing, and are not going overboard on either side; but they are caught between opposing demands of pressure groups. They need more factual information.

I wish I could give you more detail on this Conestoga Report. It will eventually be published and I think will appear *en toto*. It is one report which is being used to a considerable extent from the standpoint of determinations somewhat related to problems with which we are working.

MR. H. F. HEBLEY.[4]—In connection with the proposed program, I wish to draw attention to the work of A.S.T.M. Committee E-11 on Quality Control which is looking into the question of ascertaining if the modern statistical techniques could be applied to various sampling problems. This committee has been doing a great deal of work.

This particular committee studies the application of statistics to the planning and the design of experiment in order that one may obtain what is one of the most difficult things—namely, a representative sample.

I feel sure that if Committee D-19 will discuss with the members of Committee E-11 some of their problems it may arrive at a pattern of sampling.

[4] Director of Research, Pittsburgh Consolidation Coal Co., Pittsburgh, Pa.

In regard to the discussion by Messrs. Beal and Braley, I should like to have Mr. Braley outline to the audience some of the work that was carried out by the Philadelphia Academy of Natural Sciences on the investigation of the Conestoga drainage basin. I hope I am not putting him in an embarrassing position; but it was excellent work carried to the point which indicates just about how far one can go in regard to industrial wastes and still maintain satisfactory aquatic life in the streams. It is a measured, dignified report that avoids the emotion demands of the Isaac Walton Leagues and the Women's Clubs. It is believed that legislation expresses the will of the people; but, if such legislation does not conform to natural law, all the legislation that you write will be nullified.

MR. HENRY B. LEA.[5]—There is one phase of the problem of water-borne wastes which has not been mentioned. That phase is the psychophysical phenomenon of appearance—how does the waste appear before it enters the stream, and how does the stream appear after the waste has entered it?

This phenomenon must be considered, especially from the standpoint of public acceptance of the condition of a stream. Measurement of this property in any sort of meaningful units seems to present a problem of considerable difficulty.

[5] Analytical Chemist, Industrial Laboratory, Eastman Kodak Co., Rochester, N. Y.

Discussion of the Paper on Determining Elongation at Maximum Load in the Tension Test[1]

MR. WILLIAM R. OSGOOD[2] (*by letter*).—The method of the authors is ingenious and as good as Eqs. 7 and 8 on the validity of which it depends.

Another method, based only on the assumption that the end of uniform elongation and the beginning of "necking" occur at the maximum load, is the following: Measure stresses and corresponding strains on two gage lengths, 1 and 2 in the accompanying Fig. 1. So long as the elongation is uniform, the strains in the two lengths will be equal and increase with increasing load. At the maximum load, however, the strain in at least one of the lengths

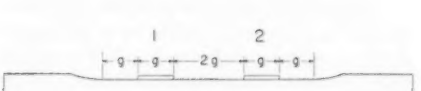


Fig. 1

will cease to increase as the specimen continues to be pulled. The strain at maximum load is the smaller of the two maximum strains reached in the gage lengths 1 and 2.

MESSRS. P. G. NELSON AND JOSEPH WINLOCK (*authors' closure*).—The description of Mr. Osgood's method of determining elongation or strain at maximum load does not, it seems to us, make completely clear the gage length specimen which he would use. To have sufficient space to attach two extensometers some distance apart as shown by his sketch, a gage length greater than 2 in. would probably be required. Longer specimens require more time and care in maching and this is a complication which we have tried to avoid.

Even though, however, a longer specimen is used there is still some doubt in our minds that it is possible always to determine strain at maximum load by Mr. Osgood's method. Most materials are fairly uniform and do not "neck" in a narrow restricted region but "neck" over a rather long gage length. In this case and even though the gage lengths which are being measured are widely separated, the same amount of "necking" may occur in both gage lengths. In this case there would not be a markedly different strain in one gage length as compared to the other at maximum load nor would the strain cease increasing. As a result, the strain at maximum load would be difficult to determine.

[1] P. G. Nelson and Joseph Winlock, "A Method of Determining the Percentage Elongation at Maximum Load in the Tension Test," ASTM BULLETIN, No. 156, January, 1949, p. 53 (TP 15).

[2] Structural Mechanics Laboratory, David Taylor Model Basin, Washington 7, D. C.

Some Notes on the Effect of Testing Machines on the Tensile Properties of Plastic Films*

By Ladislav Boor[1]

SYNOPSIS

In the evaluation of plastic and elastomeric films for Army use, the simple measurement of tensile strength and elongation by conventional methods is not adequate. The whole pattern of stress-strain relationships from zero load to final failure is necessary to judge the suitability of various film materials for the wide variety of Armed Service use.

Data were collected in an investigation of various tension testing methods in revealing these patterns of behavior and are presented with special emphasis on recent developments in this field.

THE Army uses large quantities of plastic film in the range 1 to 10 mils for its light weight and protective value in such items as rainwear, weapon and instrument covers, pouches, bags, water barriers in packaging, etc. In the evaluation of these films, made from a wide variety of polymers, the tensile properties and stress-strain relationships at various temperatures and ambient service conditions are of utmost importance.

From the earliest days of the film industry, based on nitrocellulose plastics, strength and elongation were measured on testing machines designed for paper and textiles, which were usually of the pendulum dynamometer type as represented by Schopper, Thwing-Albert, Scott, and similar machines. The rubber industry, with materials of enormously greater elongation, used similar machines adapted for greater elongations and pulling speeds.

However, in the early '30's, with the appearance of the low-modulus, high-elongation plastics, it was found that neither type machine fully met the needs of measuring stress-strain properties of these new materials. To fill this need, A.S.T.M. Committee D-20 on Plastics set up Method D 882–46 T,[2] developed previous to 1940 and made tentative in 1946. This procedure was adequate for testing films of nitrocellulose, cellulose acetate, regenerated cellulose, and most vinyl polymers.

Within the last 6 yr., new film materials have become commercially available, with radically different stress-strain properties, and the Method D 882 leaves much to be desired in revealing their behavior and in arriving at a satisfactory comparison between the various types.

During the past 2 yr., there have been developed three tension-testing machines embodying new features of loading, and load and elongation measurements which promise great improvements in this field. All of them utilize load-weighing mechanisms that involve no significant movement (a few thousandths of an inch at most) of the upper jaw for measuring the load (**1,2**).[3] This means that for practical purposes the movement of the lower jaw corresponds to stretch in the specimen and can be so plotted. To show the performance of these machines and to indicate their possibilities, four typical film materials were selected for comparison.

4 mil vinyl, Firestone Velon
4 mil polyethylene, Bakelite
4 mil nylon, No. 4406, du Pont
4 mil pure gum rubber

Stress-strain curves of these film materials, tested in the machine direction as recorded on two of these machines, are shown in Figs. 1 and 2 made in the Olsen (**3**) and Instron (**4, 5, 6**) machines, respectively. It is seen that they fall into four distinct classes:

1. The vinyl shows a steady increase of load to break, with the slope of the stress-strain curve (modulus) steadily decreasing.

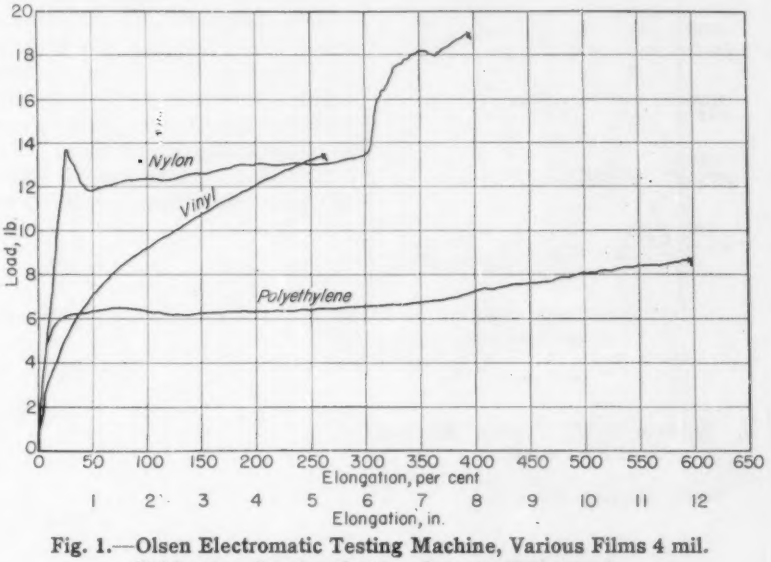


Fig. 1.—Olsen Electromatic Testing Machine, Various Films 4 mil.
Width, 1 in. Gage length, 2 in. Jaw rate, 12 in. per min.

2. In the pure gum, the load increases to break, with slope (modulus) fairly uniform up to about 300 per cent elongation, then a steady increase to break.

3. Polyethylene has a sharp rise of high modulus, with a sharp yield point, then an enormous elongation at practically the same load up to break.

4. Nylon has a very high initial elastic rise, then a sharp drop of load at the yield point, a long region during which the necked-down portion travels over the entire test section, then a gradual rise of load with a new modulus to the final break.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at a meeting of Subcommittee VIII on Research of Committee D-20 on Plastics held in Atlantic City, November 17, 1948.

[1] Laboratory Director, Chemicals and Plastics Laboratory, Philadelphia Quartermaster Depot, Phila., Pa.

[2] Tentative Method of Test for Tensile Properties of Thin Plastic Sheets and Films (D 882–46 T), 1946 Book of A.S.T.M. Standards, Part III-B, p. 911 (now revised as D 882 – 49 T).

[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

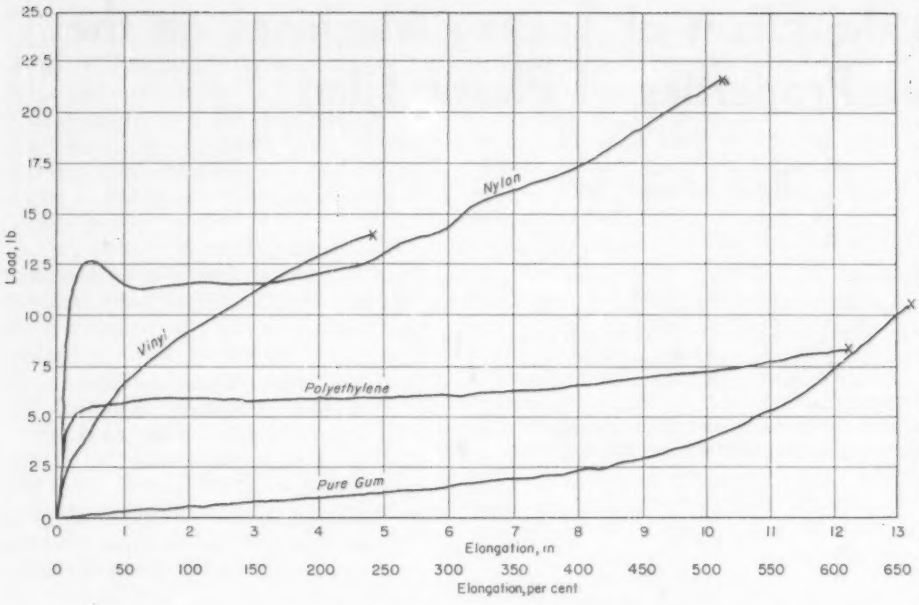


Fig. 2.—Instrom Testing Machine, Various Films 4 mil.

Width, 1 in. Gage length, 2 in. Jaw rate, 10 in. per min. Chart rate, 12 in. per min. 50-lb. dynamometer, 25-lb. full scale.

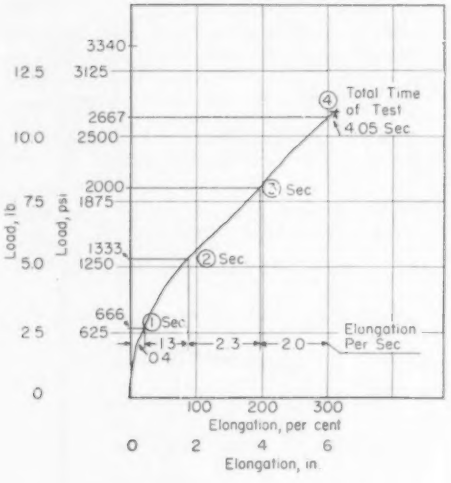


Fig. 3.—Baldwin MTE Testing Machine, Vinyl Film 4 mil.

Width, 1 in. Gage length, 2 in. Jaw rate, 12 in. per min. 25-lb. full scale. Factor 250.

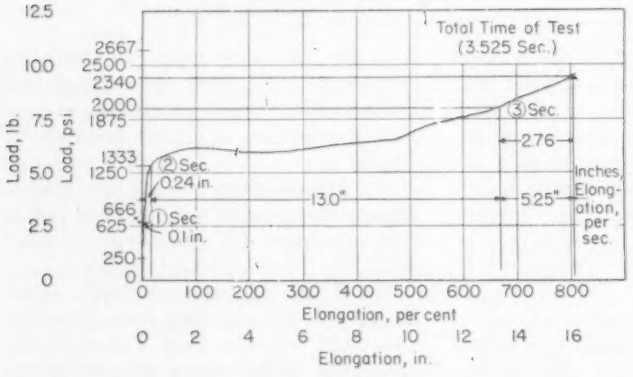


Fig. 4.—Baldwin MTE Testing Machine Polyethylene 4-mil Film.

Width, 1 in. Gage length, 2 in. Jaw rate, 12 in. per min. 25-lb. full scale. Factor 250.

From this, it is apparent that it might be possible, by variations in the above compounds, to arrive at the same tensile strength and elongation by following widely different paths of stress-strain. Since most materials find their usefulness at stresses far below the breaking point, a knowledge of the pattern of behavior at these lower stresses is essential to their intelligent utilization.

The sharp elastic rise of both polyethylene and nylon are indicative of these materials' "rattly" or "papery" nature at low elongation.

It should be noted that this investigation does not pretend to cover exhaustively the stress-strain properties of these materials, and only typical curves are shown.

An analysis of what would be expected to occur when such films are tested by Method D 882 procedure is shown in Figs. 3, 4, and 5, which represent three of the materials tested in the Baldwin Mechanical-Tate-Emery (MTE) machine.

Method D 882 states that the testing machine be of the "constant rate of loading type" and that the tension be applied at a constant rate of 40,000 psi. per min. (666 psi. per sec.).

Figure 3 shows the loading rates and times involved in testing a 4-mil vinyl specimen.

The first second, 666 psi. (2.66 lb. on a 0.004 by 1-in. specimen) are applied, the elongation is 0.4 in. in 2 in. In the next second, an additional 666 psi. (1333 total) is applied, resulting in an additional stretch of 1.3 in. Successive increments of 666 psi. per sec. are added up to failure, which would take place in 4.05 sec. Since the material has a fairly uniform stress-strain relationship, the elongations for each successive increment of load are not widely different.

Figure 4 shows the same analysis for polyethylene. In the first second, 666 psi. are applied, resulting in an elongation of 0.1 in. per 2 in. The next second has 1333 psi. on the specimen with

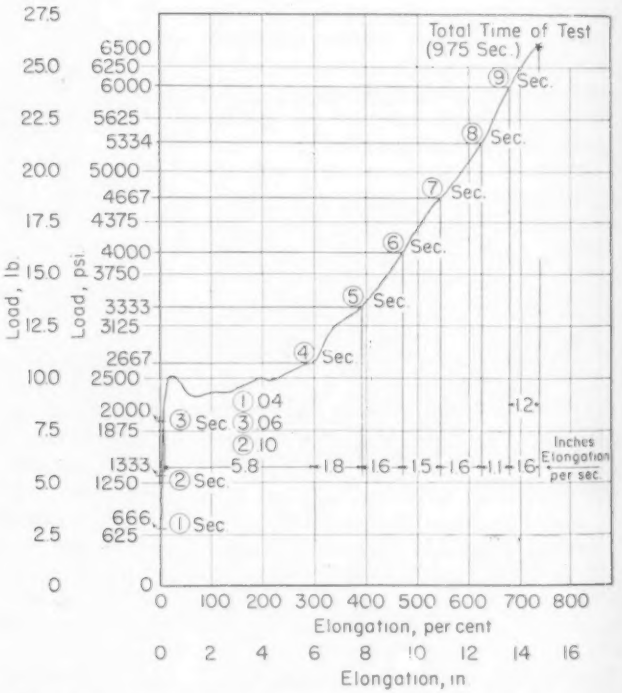


Fig. 5.—Baldwin MTE Testing Machine Nylon Film 4 mil.

Width, 1 in. Gage length, 2 in. Jaw rate, 12 in. per min. 25-lb. full scale. Factor 250.

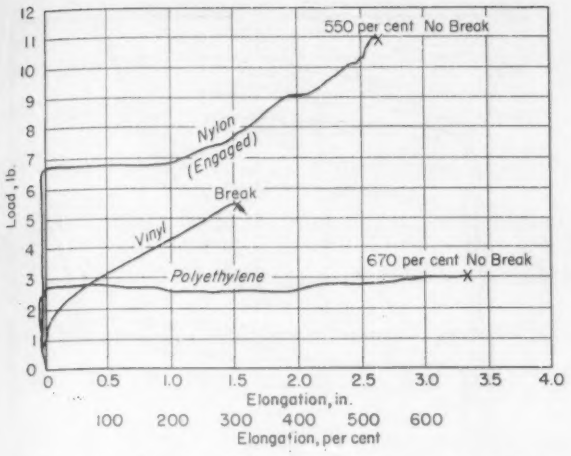


Fig. 6.—Suter Tensile Tester Pawls Disengaged Various Films 4 mil.

Width, ½ in. Gage length, ½ in. Jaw rate, 12 in. per min.

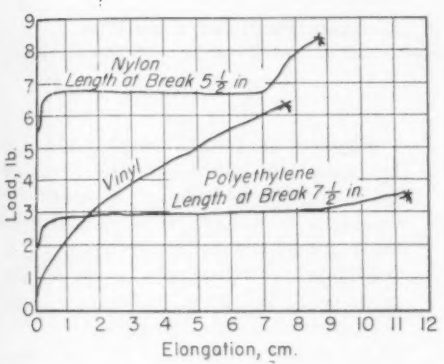


Fig. 7.—Schopper Paper Tester 15-lb. Full Scale Various Films 4 mil.

Width, ½ in. Jaw rate, 6 in. per min.

	Gage Length, in.	Pawls
Vinyl	1	Disengaged
Polyethylene	¼	Disengaged
Nylon	⅛	Engaged

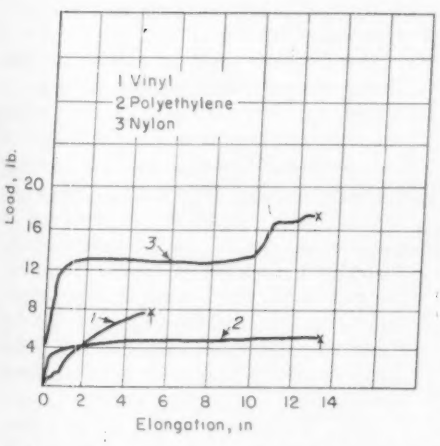


Fig. 8.—Scott Rubber Tester L6 Pawls Disengaged Various Films 4 mil.

Width, 1 in. Gage length, 4 in. Jaw rate, 12 in. per min., 60 lb. full scale.

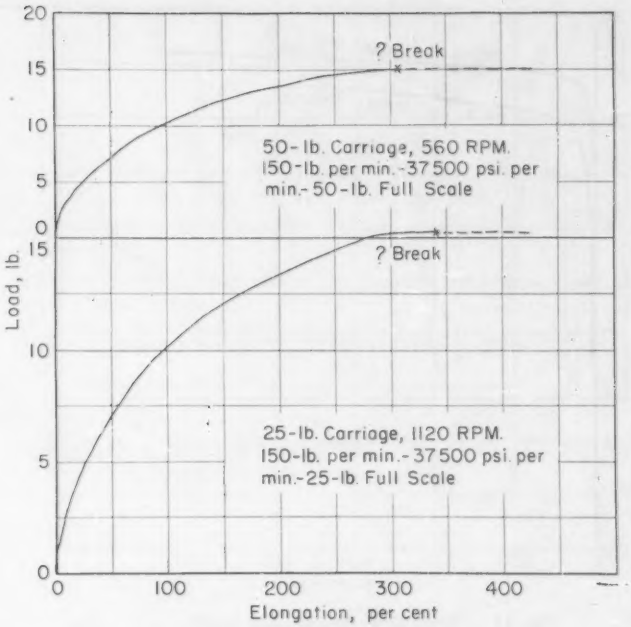

? Break
50-lb. Carriage, 560 RPM.
150-lb. per min.-37500 psi. per min.-50-lb. Full Scale
? Break
25-lb. Carriage, 1120 RPM.
150-lb. per min.-37500 psi. per min.-25-lb. Full Scale
Load, lb.
Elongation, per cent

Fig. 9.—Scott IP4 Vinyl, 4 mil.

150 lb. per min., 37,500 psi. per min. Film width, 1 in. Gage length, 2 in

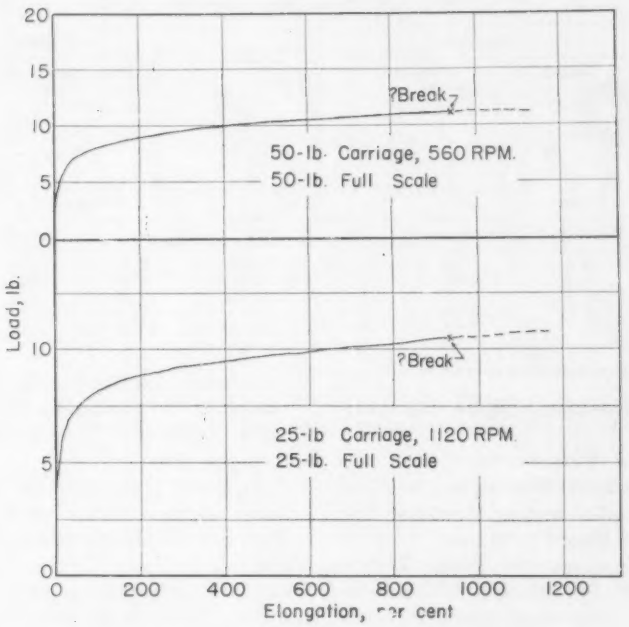


Fig. 10.—Scott IP4 Polyethylene, 4 mil.

150 lb. per min., 37,500 psi. per min. Film width, 1 in. Gage length, ¾ in.

0.24 in. elongation in 2 in. In the third second, another 666 psi. must be added; but now we are in a critical region where the material elongates enormously, and inside of one second we must pull out a stretch of 13 in. and still record the rising load shown by the final end of the curve, and the total test would take about $3\frac{1}{2}$ sec.

Figure 5 shows a similar curve for nylon. Obviously, since the load applied is constantly increasing, the yield point shown just after 3 sec. could be suggested only by a horizontal line where the load is traveling at infinite speed and trying to catch up to the point where the material will bear its next increment of load, 2667 psi. at 4 sec. From this point on, the load rises uniformly to failure with a total time of 9.75 sec.

It is doubtful that any machine can be constructed so free of friction as to follow these irregularities of deformation rate, and even if it could be, we still have the inertia of a mass to be accelerated to 13 in. per sec. (Fig. 4), and then slowed down to catch the final

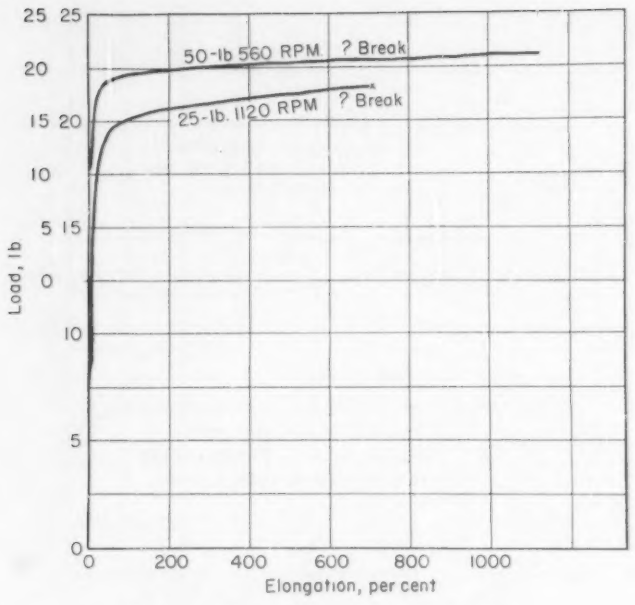


Fig. 11.—Scott IP4, Nylon Film 4 mil.

150 lb. per min., 37,500 psi. per min. 50-lb. carriage 560 rpm. 25-lb. carriage 1120 rpm. Width, 1 in. Gage length, ¾ in.

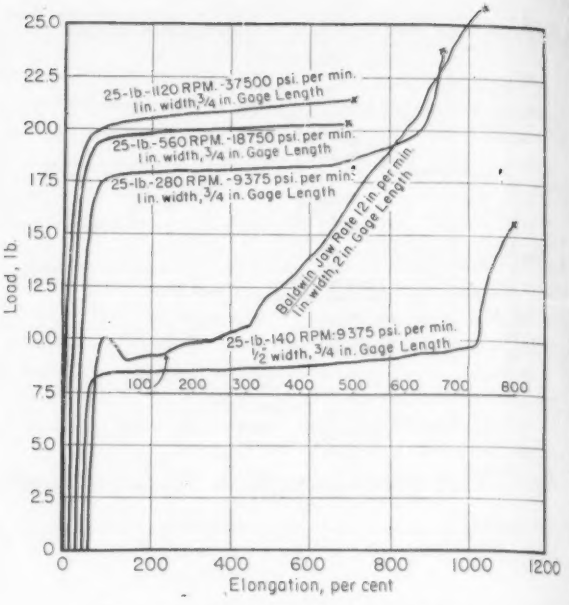

25-lb.-1120 RPM.-37500 psi. per min.
1 in. width, ¾ in. Gage Length
25-lb.-560 RPM.-18750 psi. per min.
1 in. width, ¾ in. Gage Length
25-lb.-280 RPM.-9375 psi. per min.
1 in. width, ¾ in. Gage Length
Baldwin Jaw Rate 12 in. per min.
1 in. width, 2 in. Gage Length
25-lb.-140 RPM-9375 psi. per min.
½ width, ¾ in. Gage Length
Load, lb
Elongation, per cent

Fig. 12.—Scott IP4, Nylon, 4-mil Film.

25-lb. carriage. Various rates of loading width and gage length as indicated.

TABLE I.—TESTS ON NYLON 4-MIL FILM.
Scott IP4 Tester. 25-lb. Carriage.

	Specimen		Drive, rpm.	Load Rate per Min.	
	Width, in.	Length, in.		Lb. on Specimen	psi.
No. 1	1	¾	1120	150	37 500
No. 2	1	¾	560	75	18 750
No. 3	1	¾	280	37.5	9 375
No. 4	½	¾	140	18.8	9 375
No. 5	1	2	...	Constant strain	

	Yield	Yield	Break		Elongation		
	Point, lb.[a]	Point, psi.	lb.	psi.	in.	per cent	Notes
No. 1	20.5	5120	24.5	6130	5.5	730?	No rise
No. 2	19.5	4880	20.2	5050	5.2	690?	No rise
No. 3	17.7	4420	23.8	5950	6.9	920	Rise
No. 4	8.5	4250	15.5	7750	8.1	1080	Rise
No. 5	10.0	2500	26.0	6500	14.8	740	Rise

[a] Estimated on flattening part of curve.

rise in load without ripping the specimen.

The stress-strain curves of these materials were determined in several other types of tension-testing machines and are shown in Figs. 6 to 21.

Figure 6 shows the Suter Tensile Tester, 12-lb. full scale, as used for textile testing. For some reason inherent in the mechanical recording system, the initial load rise was always recorded on the negative side of the zero line. The maximum jaw travel was insufficient to break the samples of high elongation, even with only ½-in. original test length. This machine uses a pendulum weighing system with holding pawls on a sector. When the pawls are disengaged, yield points (if not too sudden) can be shown as a drop in the load (polyethylene), or when engaged, as a horizontal line (nylon).

Figure 7 was made on the Schopper Paper Tester (pendulum weighing system) of 15-lb. full capacity. Again, the stroke is limited and test lengths as short as ¼ in. and ⅛ in. were required to produce breaks within the range of stroke of the machine. In these latter tests, there was considerable pull-out from the jaws.

Figure 8 shows curves made in the Scott Rubber Tester, 60-lb. full scale. This has ample stretching capacity to break a 4-in. gage length, but the loads involved in breaking these thin films utilize only a small portion of the load scale, and the curves are too small to be practical.

A study was made of a constant rate of loading type of machine (such as Scott I P4), as required by Method D 882, and its operation in testing these films. The nominal increase of load of 40,000 psi. per min. would require, on an 0.004 by 1-in. cross-section, 160 lb. per min. The nearest calibrated value for the particular machine used was 150 lb. per min. (37,500 psi. per min.). This can be obtained by two possible methods:

1. Use of a 50-lb. carriage and a slow rate of tilt (560 rpm.).
2. Use of a 25-lb. carriage and a fast rate of tilt (1120 rpm.).

Figure 9 shows the vinyl film tested by these two methods. The breaking loads and elongations are substantially the same, as far as can be judged from the trace of the rapidly moving pen at the break. Polyethylene, under the same conditions (2-in. test length), did not break within the elongating capacity of the machine (10 in.). Several trials at shorter gage lengths showed that at ¾-in. gage length, breaks could be obtained.

Figure 10 shows polyethylene tested under these conditions. Note the lack of sharp yield point and the gradual rise of load up to a very uncertain breaking load and elongation. The difference between this and Fig. 4 should be noted.

Figure 11 shows nylon tested in the same manner. No yield point or final rise is observable, and the break and elongation points can only be estimated. Compare with Fig. 5.

It is obvious that the rate of loading under these conditions is so high as to overshoot the yield point, so that when the specimen begins to yield, it is pulled out to break by the rapidly moving carriage and any estimates of the location of the break, either on the load or elongation scale, are meaningless. Whether the specimen breaks or not at the end of the yield point, is determined not by the nominal loading rate, but by the inertia of a 50-lb. mass running down a slowly tilting incline, or a 25-lb. mass running down a rapidly tilting incline.

Some trials were made using nylon and reducing this high rate of loading in an attempt to approach the behavior shown on the other type machines.

Figure 12 shows curves made using

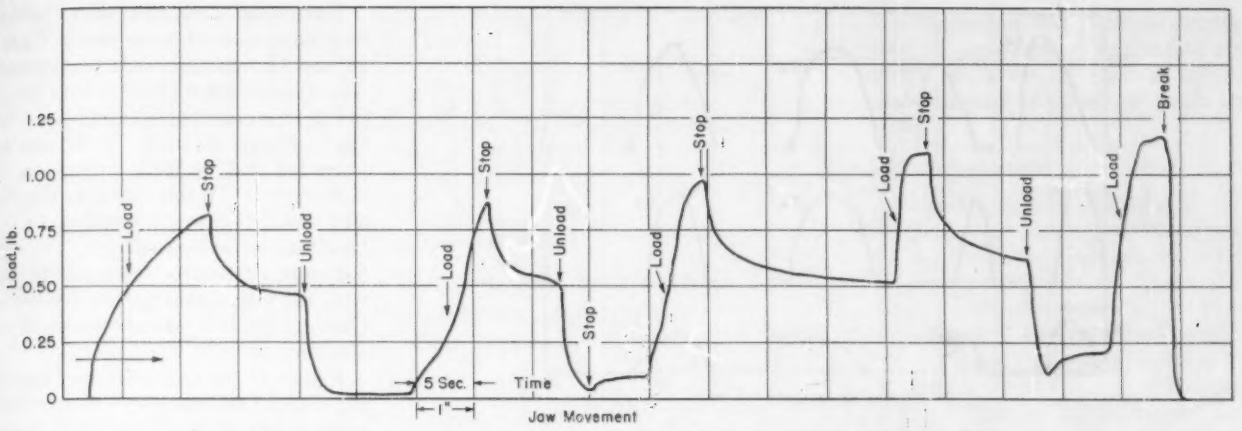


Fig. 13.—Instron Testing Machine, Cycling Load Tests Vinyl Film 4 mil.
⅜-in. width. 2-in gauge length. Full scale, 25 lb. Jaw rate, 12 in. per min. Chart rate, 12 in. per min.

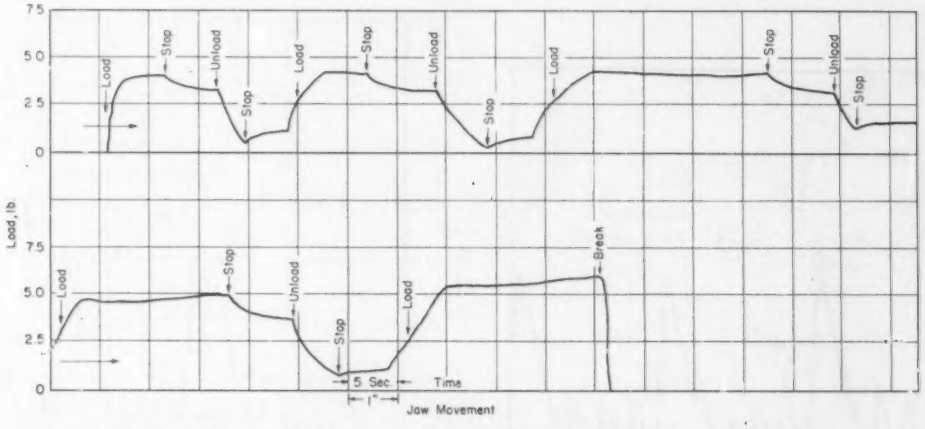


Fig. 14.—Instron Testing Machine, Cycling Load Tests Polyethylene Film 4 mil.
¾ in. wide. 2-in. gage length. 25-lb. full scale. Jaw rate, 12 in. per min. Chart rate, 12 in. per min.

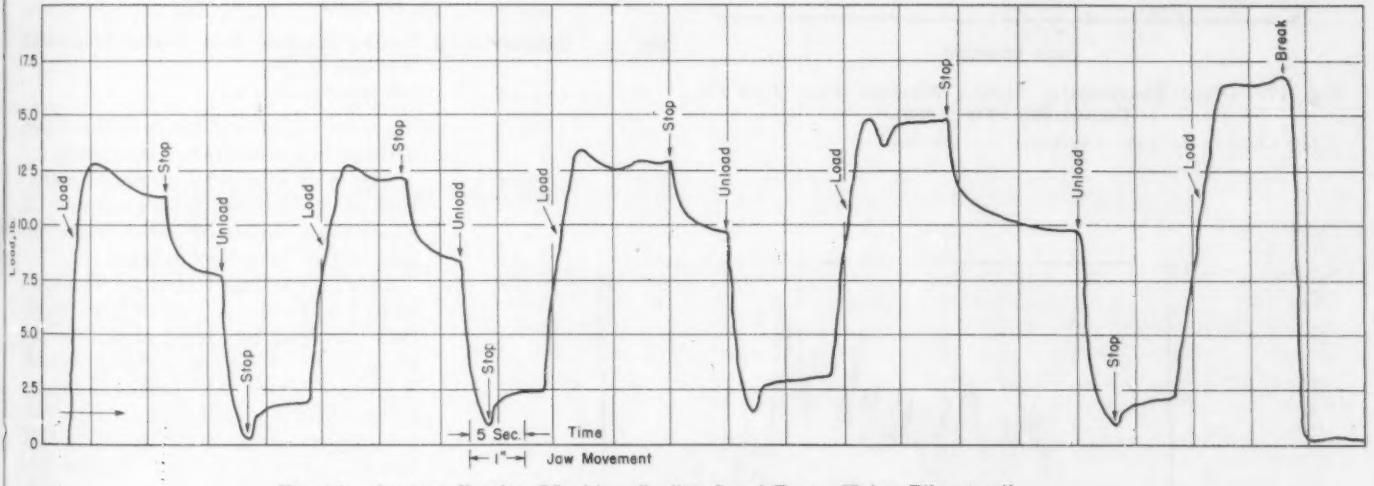


Fig. 15.—Instron Testing Machine Cycling Load Tests, Nylon Film 4 mil.
¾ in. wide. 2-in. gage length. 25-lb. full scale. Jaw rate, 12 in. per min. Chart rate, 12 in. per min.

the 25-lb. carriage and reducing the rate of tilt as follows:

Specimen Width, in.	Speed, rpm.	Rate of Stressing, psi. per min.
1	1120	37 500 (Method D 882 – 46 T)
1	560	18 750
1	280	9 375
½	140	9 375

Note that only the last two determinations, where the rate of stressing was around 9000 psi. per min., revealed the final load rise after the yield point.

The stress-strain curve made on the Baldwin MTE machine (Fig. 5) is superimposed for comparison.

Table I shows a summary of these curves. Note the steady drop of the yield point as rate of load decreases. The tensile strength varies irregularly (in the few specimens tested). The elongation, in general, rises with decreased rates of loadin

Some other valuabl uses of the new type machines are shown.

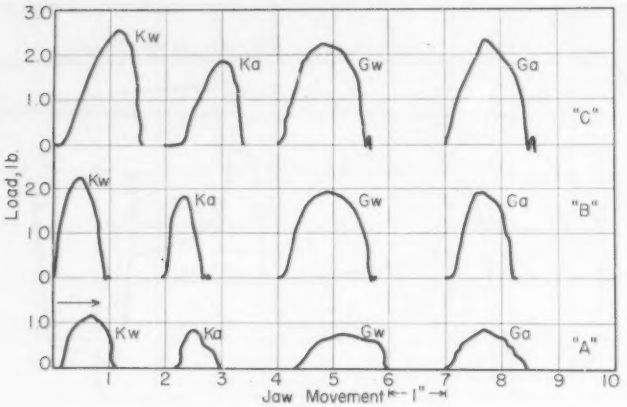


Fig. 16.—Olsen Electromatic Testing Machine Kidney and Graves Tear Tests Various Plastic Films.

Jaw rate, 12 in. per min. Chart rate, 12 in. min. 10-lb. full scale.

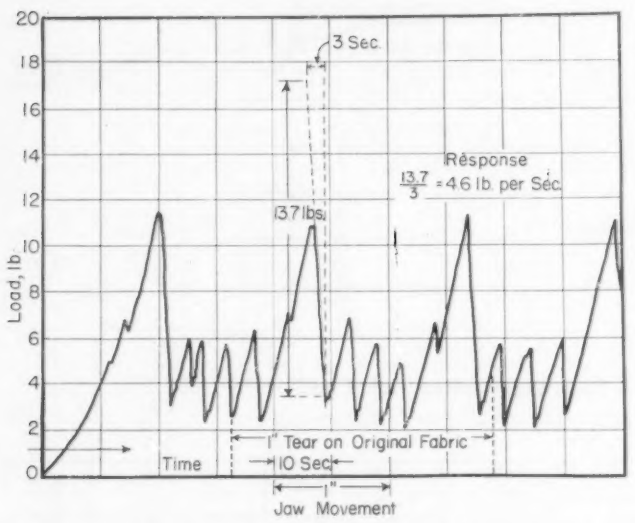


Fig. 17.—Olsen Electromatic Testing Machine Tear Test GRS Coated Rip Stop Nylon.

Jaw rate, 3 in. per min. Chart rate, 6 in. per min.

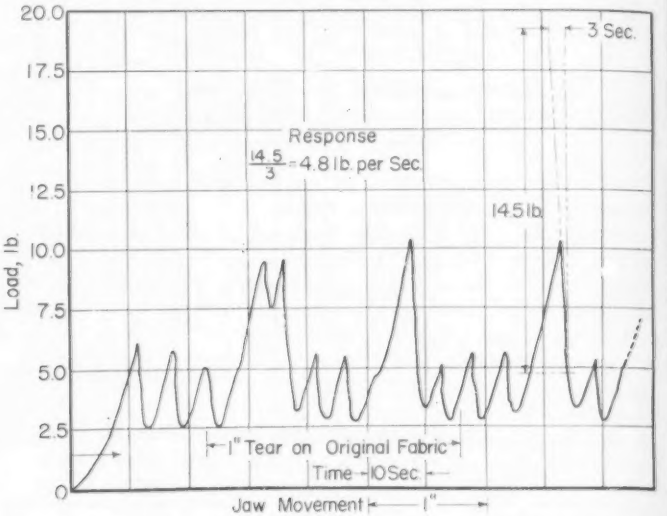


Fig. 18.—Baldwin MTE Testing Machine Tear Test GRS Coated Rip Stop Nylon.

Jaw rate, 3 in. per min. Chart rate, 6 in. per min.

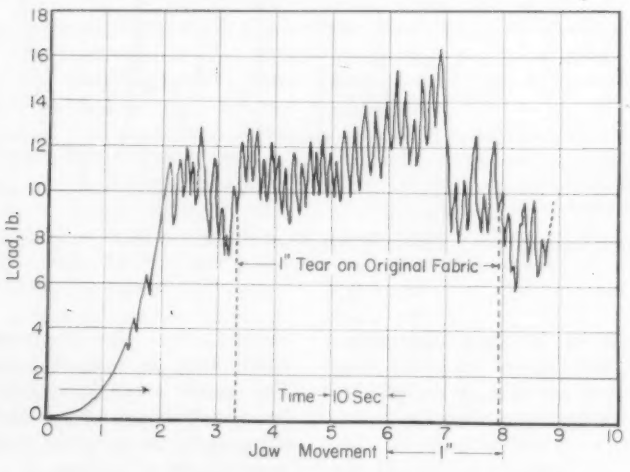


Fig. 19.—Olsen Electromatic Testing Machine Tear Test Uncoated 1.6-oz. Nylon Twill.

Jaw rate, 3 in. per min. Chart rate, 6 in. per min.

Hysteresis and relaxation behavior may be evaluated, as shown in Figs. 13, 14, and 15, made on the Instron machine where increments of load are applied, the jaw movement stopped, and relaxation of load followed in time. When partially unloaded and stopped, increase of load is observed. In this manner, the stress and elongation corresponding to 0 relaxation can be located.

Figure 16 shows load curves made with the Olsen machine on Kidney and Graves type test tear specimens of various vinyl films.

Figure 17 shows variation of load during a tear test made on a rubber-coated nylon fabric of rip stop construction.

Figure 18 shows the same material tested in the Baldwin machine.

Figures 19 and 20 show tear tests on uncoated nylon twill made on the Olsen and Baldwin machines, respectively.

Figure 21 illustrates another application of the Instron type machine. It shows the variation of load during stripping of $\frac{3}{4}$-in. wide Scotch tape.

In a tongue tear test made at a slow (2 to 4 in. per min.) rate of jaw separation, the load builds up slowly as the yarns in the V-shaped dell are aligned. A group of yarns then breaks suddenly, and the load is instantaneously removed.

Using the slope of the dropping load in a tear test as an index of response, the following table shows a comparison of the various load-weighing systems at the time these tests were made.

20 to 25-lb. Full-Scale Load Range		
Olsen	4.8	lb. per sec.
Baldwin	4.6	lb. per sec.
Instron (old model)	10	lb. per sec.
Instron (new model)	20	lb. per sec.

Naturally, this response will vary with the load range used, and the degree of sensitivity required will be determined.

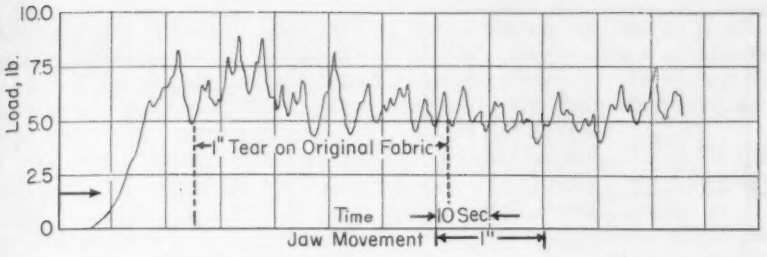


Fig. 20.—Baldwin MTE Testing Machine Tear Test, Uncoated 1.6-oz. Nylon Twill.

Jaw rate, 3 in. per min. Chart rate, 6 in. per min. 25-lb. full scale.

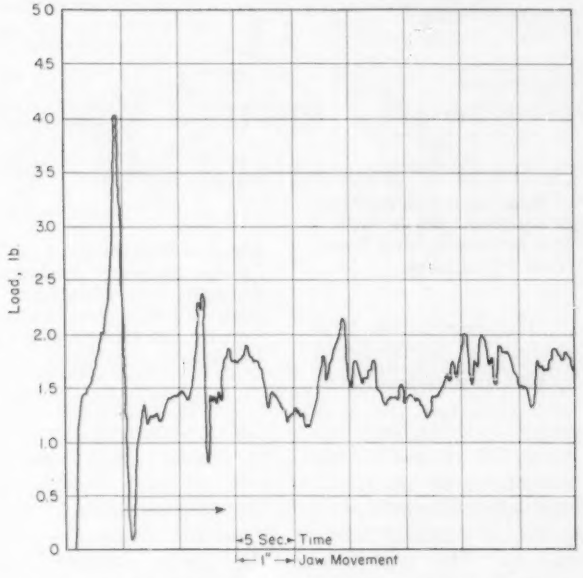


Fig. 21.—Instron Testing Machine Adhesion Test, ¾-in. Scotch Tape.

Full scale, 5 lb. Jaw rate, 12 in. per min. Chart rate, 12 in. per min.

by the requisite recording of load changes taking place during short time intervals.

It is believed that tension-testing machines utilizing dynamometer systems involving negligible movement of the upper jaw will find an increasing field of usefulness in evaluating stress-strain behavior of various polymeric materials and of structures made therefrom.

Acknowledgments:

Acknowledgment is made of the assistance in supplying samples, use of testing machines, and helpful criticism of the following: B. L. Lewis, Tinius Olsen Testing Machine Co.; F. G. Tatnall, Baldwin Locomotive Works; H. Hindman and G. S. Burr, Instron Engineering Corp.; W. J. Hamburger, Fabric Research Laboratories; C. H. Adams, Monsanto Chemical Co.; and C. R. Stock, American Cyanamid Co.

Our thanks is offered to the Office of the Quartermaster General for permission to publish this work.

REFERENCES

(1) C. H. Adams, "New Apparatus for Film Testing," ASTM BULLETIN, No. 140, May, 1946, p. 62.

(2) J. W. Ballou, "A Stress Strain Tester for Textiles Employing a Magnetic Strain Gage," *Ibid.*, No. 150, January, 1948, p. 38 (TP10).

(3) H. F. Schieffer, "Measurement and Elimination of Inertia Effects in Textile Testing Equipment by Means of Electric Strain Gages," *Ibid.*, p. 43 (TP15).

(4) George S. Burr, "Servo Controlled Tensile Strength Tester," *Electronics*, May, 1949.

(5) E. V. Painter, "Some Aspects of the Aging of Coated Fabrics," *Proceedings*, Am. Assn. Textile Chemists and Colorists, October, 1947.

(6) E. R. Kaswell, "Low Temperature Properties of Textile Materials," *Ibid.*, October, 1948.

Discussion of Paper on Effect of Speed of Testing Stainless Steel Sheet[1]

MR. J. H. WESTBROOK.[2]—Mr. Heyer is to be congratulated for his fine presentation of this most informative study. The time to fracture procedure for controlling the speed of testing, described in this paper, seems worthy of more extensive application. I should however, like to bring up a few questions relative to the data presented.

The data shown in this paper indicate that low strain rates produced *higher tensile strengths* as well as high elongations. This seems to me to contradict the findings of most other investigations of the effect of strain rates as have recently been reviewed by Hollomon and Jaffe.[3]

The author states in his conclusion, "It is clear that the speed sensitivity of the austenitic stainless steels is a reflection of their sensitivity to the effects of cold working at various temperatures in the vicinity of room temperature." While this may be, and probably is, true it does not seem to be conclusively demonstrated by the data shown.

It must be observed that strain rate and temperature are two separate and distinct factors, each of which affects the stress-strain relations for a metal. Further, each of these factors has a two-fold effect. That is, the temperature of test has a direct effect in that an increase in temperature usually lowers and decreases the slope of the whole stress-strain curve, but it may also have a secondary effect in that changes in temperature can cause structural changes in the metal during the process of deformation. Likewise, the strain rate factor includes a temperature effect through induced changes in adiabaticity as well as the direct effect of strain rate. While the "damp cloth" and other tests reported by the author definitely demonstrate the effect of increased adiabaticity caused by increased speed of testing, they do not seem to prove that there is no direct effect of strain rate itself. Further, it is not shown whether the noted influence of the temperature factor is not, in part at least, due to its secondary or structural effect. Metallographic studies and

[1] R. H. Heyer, "Effect of Speed of Testing on the Tensile Properties of Austenitic Stainless Steel Sheets," ASTM BULLETIN, No. 158, May, 1949, p. 57 (TP83).

[2] Research Associate, General Electric Research Laboratory, Schenectady, N. Y.

[3] Hollomon and Jaffe, "Ferrous Metallurgical Design," John Wiley & Sons, Inc., New York, N. Y., pp. 112–121, 136–140 (1947).

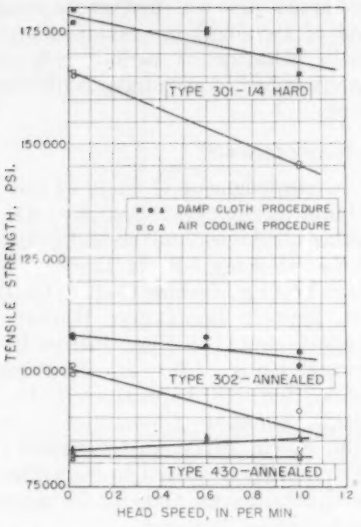


Fig. 1.—Effect of Head Speed on Tensile Strength of Three Stainless Steels with a Comparison of the Air Cooling and Damp Cloth Test Procedures.

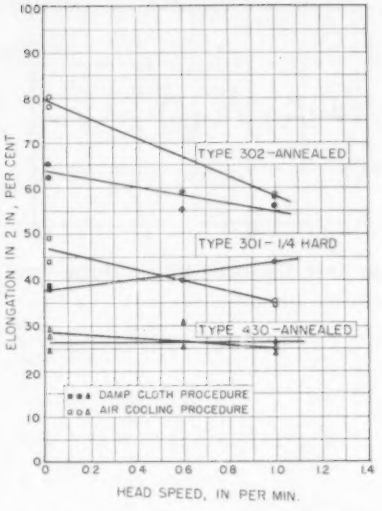


Fig. 2.—Effect of Head Speed on the Elongation of Three Stainless Steels with a Comparison of the Air Cooling and Damp Cloth Test Procedures.

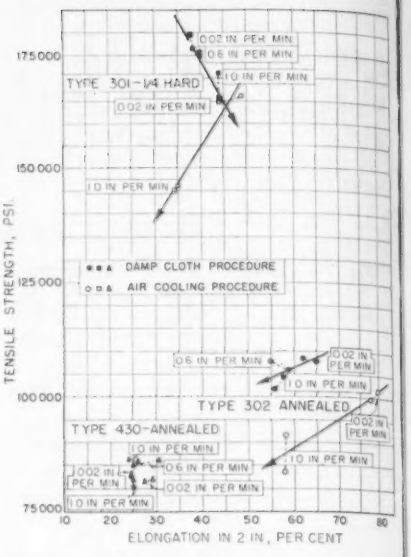


Fig. 3.—Tension Tests on Three Stainless Steels Showing Variations in Tensile Strength and Elongation with Different Head Speeds and Comparing the Air Cooling and Damp Cloth Test Procedures.
Direction of arrows shows the general effect of increasing head speed.

other additional experiments to establish these points seem to be indicated.

A review of the data presented in Tables VI and VII permits further observations than those reported by Mr. Heyer. I have taken the liberty of presenting these data graphically in two different ways in order to show the relations between strength, elongation, and testing speed more clearly. These plots are shown in the accompanying Figs. 1, 2, and 3. It is of course possible that some conditions or circumstances not reported in the paper invalidate this procedure; but, if such is not the case, a number of interesting observations may be made.

1. In the air-cooled tests, all steels show high strength and elongation at low strain rates and low strength and elongation at high strain rates except the annealed type 430 steel which is seen to be relatively speed insensitive. This is in complete accord with the other results reported by Heyer.

2. In the damp cloth tests, all steels still show an effect of testing speed on strength. While in the case of the type 302-annealed and type 301 ¼ hard, this effect is the same as that found in air-cooled tests, the type 430-annealed steel shows a slight but definite opposite effect, that is, increases in strain rate increased the strength.

3. All steels show that the effect of testing speed on strength is reduced slightly by the damp cloth procedure.

4. In the damp cloth tests, the effect of testing speed on the elongation of type 302-annealed specimens is the same as that for all the air-cooled tests. The type 301 ¼ hard steel, on the other hand, shows a slight opposite effect, that is, increases in strain rate increased the elongation. The data for the type 430-annealed steel do not permit determination of the sign of its slight speed effect.

5. As a consequence of (4), the damp cloth tested type 301 ¼ hard steel shows lower elongations at low strain rates and slightly higher elongations at high strain rates than the corresponding air-cooled specimens. The type 302-annealed steel showed lower elongations at all strain rates. Little or no change can be observed for the type 430-annealed stock.

Mr. Heyer's comments on the significance (if any) of these observations would be appreciated.

I should also like to know what explanation Mr. Heyer would offer for the failure of the carefully designed experiments on the effects of specimen preparation to reproduce the high strengths and elongations found by one laboratory for hand-stoned specimens.

MESSRS. R. H. HEYER[4] AND R. A. LINCOLN[5] (*authors' closure*).—Mr. Westbrook's discussion is directed principally at the damp cloth tests which Mr. R. A. Lincoln conducted on the same materials used in the round-robin tension tests. Mr. Lincoln has collaborated in this closure.

Austenitic stainless steels differ from other common metals in that at room temperature they have a very high rate of work hardening, and relatively slight changes in temperature cause this rate of work hardening to change. Increasing the temperature lowers the rate of work hardening, and decreasing the temperature increases the rate of work hardening. The change in tensile strength with rate of work hardening is linear, and the greater the rate of work hardening, the greater the tensile strength obtained. However, the elongation that accompanies the tensile strength does not change linearly but has a maximum value at an optimum rate of work hardening, and can be less at very low rates of work hardening as well as at relatively high rates of work hardening. The effect of changes in temperature on the rate of work hardening of the specimen during pulling at different rates has such a great influence that it masks other influences of the rate of testing. With material such as carbon steel, that has a relatively low rate of work hardening that remains approximately constant over the temperature range in which specimens can vary during pulling, increasing the rate of testing would be expected to have an entirely different effect from that noted in austenitic stainless steels. With the rate of work hardening remaining constant, the principal effect noted appears to be the result of the manner in which plastic deformation takes place as the rate of deformation increases.

In the damp cloth tests, the cloth was wet with tap water which was somewhat colder than room temperature. Thus, the initial temperature of the test specimen was somewhat below room temperature. The heat generated during pulling caused the temperature to rise, and at the fastest rate of pulling of 1 in. per min. it is estimated that the temperature of the test specimens approached room temperature. It is

[4] Research Laboratories, Armco Steel Corp., Middletown, Ohio.
[5] Sales Development and Engineering Service Dept., Allegheny Ludlum Steel Corp., Brackenridge, Pa.

to be expected, therefore, that the effect of pulling speed on the tensile strength and elongation will still be evident in the damp cloth tests. The shift in level of the curves in Figs. 1 and 2 of the discussion reflects the higher work hardening at the lower temperatures of the damp cloth tests, but it is not claimed that this procedure maintains a constant test temperature.

The elongation changes of type 301 ¼ hard with testing speed indicate that the optimum elongation is obtained at a temperature close to room temperature (produced by the highest testing speed in the damp cloth test and the lowest testing speed in air).

While the author concluded that the speed sensitivity of the austenitic stainless steels was a reflection of their sensitivity to the effects of cold working at various temperatures, it is well known that these materials do undergo a structural transformation during plastic deformation, as Mr. Westbrook suggests; hence it might be stated better that the testing speed influences the test temperature which influences the rate of transformation of the austenite.

The failure of the experiments on the effect of specimen preparation to confirm our conviction, based on prior experience, that careful edge preparation improves the ductility remains a mystery.

Ignition and Burning Characteristics of Polyester, Phenolic, and Melamine Fibrous Glass Laminates

By H. J. Stark[1]

Synopsis

Results on ignition time and temperature and on burning time of melamine, phenolic, and polyester types of resins are compared from round-robin test data obtained at the Bureau of Mines and N. Y. Naval Shipyard laboratories. In addition, using results of data compiled at the National Bureau of Standards, the Flash and Self Ignition temperatures of these resins are compared. The conclusions reached concerning burning and ignition characteristics are: (1) Melamines, having the greatest resistance to ignition and the shortest burning times, are better than phenolics and polyesters. (2) Polyesters, having the poorest resistance to ignition and the longest burning times, are inferior to the other two types of laminates. (3) Phenolics, having ignition and burning qualities between those of melamines and the polyesters, still are much better than the polyesters. (4) Polyester resins for Naval construction need to be improved greatly. (5) More basic work in future development of the low-pressure, polyester laminates should aim to increase their flame and heat resistance.

The equipment used by the several laboratories and the test methods employed are also described.

Introduction

The Bureau of Ships has among its many functions the sponsorship of research and development in the field of resins. In its selection of laminates for its mechanical applications, the Bureau has requirements which the laminates should possess if they are to be classified by it as nonburning, self-extinguishing, or maximum strength-retaining laminates after they have been subjected to heat.

A definition of a superior structural laminate is that it is one having high initial strength, high flame resistance and strength retention when carrying loads at elevated temperatures. In regard to ignition and burning characteristics, a superior laminate is one that has a long ignition time (resists burning for a long time) and has a short burning time (burns for short periods or not at all). This laminate's weight loss upon burning is small when burned for reasonable periods.

Objective

This paper presents, discusses, and compares the data obtained on ignition and burning characteristics of one melamine, six polyesters, and two phenolic types of resin-fibrous glass laminates in tests conducted at the Bureau of Mines, the New York Naval Shipyard, and the National Bureau of Standards. The data pertaining to the melamine laminate are presented mainly to indicate the extent of improvement needed in the present commercial low-pressure, polyester laminates if they are to compete with melamine in ignition and burning characteristics.

Materials

The low-pressure resin laminates were all commercially available and were made using Owens Corning Fiberglas Cloth No. 182-14. Of the polyester laminate specimens labeled A and B, respectively, specimen A contained 5 per cent antimony trioxide. The oxide was added as a burning inhibitor. Specimen B was from material like specimen A but without the inhibitor. Specimens C to F, inclusive, were all representative of various polyester laminates. Specimens G and H were the phenolic type and specimen I was the melamine high-pressure laminate.

The samples were cured at 250 F. for 30 to 50 min. (see Table I).

Navy and Bureau of Mines Equipment

Briefly, the Navy equipment consisted of a specimen support, heater coil, spark plugs, and an enclosure of sufficient size. This apparatus, as well as the method of using it to perform flame resistance tests on thermosetting plastics, has been described previously in the literature.[2,3,4] The equipment used by the Bureau of Mines was similar but differed in one respect. The Bureau's equipment had an enclosure which was gas tight while the Navy's tester had an enclosure which was ventilated. To provide for ventilation, holes in the enclosure were distributed around the sides, adjacent to the base, to admit fresh air and an exhaust fan at the top was operated with suction sufficient only to carry off smoke and gases. A sliding door at the front of the enclosure with shatter-proof window permitted access

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Navy Department, Bureau of Ships, Washington, D. C.

[2] J. A. Gale, R. W. Stewart, and J. B. Alfers, "Determining the Flammability of Thermosetting Materials," *Plastics*, June, 1945, p. 56.

[3] J. A. Gale, R. W. Stewart, and J. B. Alfers, "Flame Resistance of Thermosetting Plastics," ASTM Bulletin, No. 131, December, 1944, pp. 23–27.

[4] Joint Army-Navy Specification, Jan-P-14, September 30, 1944.

TABLE I.—CURING CYCLE FOR IGNITION TEST PANELS, POLYESTER AND PHENOLIC RESINS.

Laminate	Fiberglas Cloth	Thickness, in.	Number of Layers Cloth	Temperature, deg. Fahr.	Pressure, psi.	Cure Time, min.
A	182-14	0.5	32	250	10.0	50
B	182-14	0.5	32	250	10.0	40
C	182-14	0.5	32	250	10.0	50
D	182-14	0.5	32	250	10.0	50
E	182-14	0.5	32	275	10.0	50
F	182-14	0.5	32	275	10.0	30
G	182-14	0.5	32	300	10.0	40
H	182-14	0.5	32	300	10.0	40

to the equipment and a clear view of the interior.

The specimen support was an ordinary four-jawed lathe chuck suitably secured to the base of the enclosure. The heater coil consisted of seven turns of No. 10 (0.102-in. diameter) Nichrome resistance wire, space wound to 0.25 in. per turn and $1\frac{3}{16}$ in. diameter. The coil ends were clamped into heavy copper lugs with the axis of the coil coincident with the axis through the opening in the specimen support and with the lower end of the coil $\frac{1}{2}$ in. above the top of the support.

Two spark plugs, with extended electrodes, diametrically opposite, were placed with their longitudinal centerlines in a horizontal plane $\frac{1}{2}$ in. above the top of the heater coil, to ignite gases omitted from the heated specimen. The spark plugs were mounted in such a manner that they could be moved to within $\frac{1}{8}$ in. of the surface of the specimen when in operation, or away from the specimen after ignition occurred. This prevented the electrodes from becoming fouled by soot. A suitable electric circuit was provided to maintain continuous sparking at the electrodes.

Current was supplied to the heater coil through the heavy lugs which was, in turn, connected to the secondary of a transformer. Current was controlled by means of a variable auto-transformer in the primary.

The test chamber was of wood construction, with glass sides and with a small window set into the door at the front of the chamber to permit observation of the specimen during the test. The inside dimensions of the chamber were $24\frac{3}{4}$ by 21 by $32\frac{3}{4}$ in., and its volume was 270 liters. The door of the chamber closed on a soft rubber gasket and was secured when closed by four refrigerator-door-type clamps. The chamber was found by test to be essentially gas tight. A baffle plate, to facilitate mixing of the chamber atmosphere, was situated 6 in. from the rear wall and extended downward from the top of the chamber to within 5 in. of the base supporting the flammability test equipment. A 4-in. fan was mounted in a circular opening near the top of the baffle. This fan was operated only after burning of the test specimen had ceased, circulation of the atmosphere in the chamber being obtained during the test by convection set up by the heating coil and by combustion of the specimen. It was possible to ventilate the chamber at the conclusion of a test by connection to an exhaust ventilation duct. This duct was closed off from the chamber by a water seal during test. To prevent undue pressure changes in the chamber during test as a result of heating and cooling the chamber atmosphere was permitted to expand through a suitable connection into a 3-in. diameter metal tube, open at one end, during operations that evolve heat. When burning of the test specimen had ceased and cooling of the chamber atmosphere ensued, the gases discharged by thermal expansion from the chamber into the tube were drawn again into the chamber from the tube by contraction due to cooling. With this arrangement, error from loss due to expansion on heating and dilution of the test chamber atmosphere during cooling was negligible.

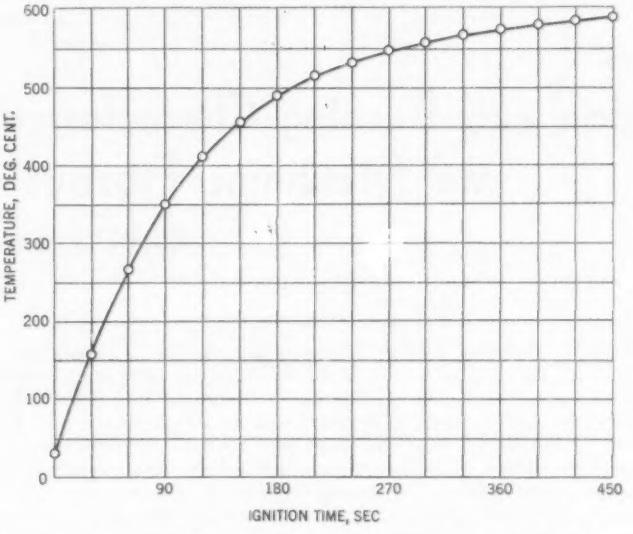


Fig. 1.—Relationship Between Ignition Time and Temperature of Plastic Test Piece; Coil Current, 55 amp.

Bureau of Standards Equipment

The equipment and method of test used by the Bureau of Standards was developed by N. P. Setchkin[5] of the Fire Protection Section of the Bureau. By carefully and accurately controlling the heat applied to the specimen, this method permits determinations of the temperature at which a combustible vapor first ignites (Flash Ignition Temperature). The vapor is ignited by a pilot flame. It is essentially a constant-air-temperature method and it permits the accurate measurement of the Self Ignition Temperature. (The Self Ignition Temperature is the temperature at which the specimen is self ignited without the aid of an external flame and it is in all cases higher than the Flash Ignition Temperature.)

Procedure

The procedure for determination of the resistance to ignition and burning was conducted on specimens $\frac{1}{2}$ by $\frac{1}{2}$ by 5 in., of the type commonly used for flexural strength tests. The laminates were cut from $\frac{1}{2}$-in. sheet stock (see Table I). The heating coil was clamped in the copper lugs and the specimen was inserted into the support, so that it was within but not touching the heater coil and extending 2 in. beyond the top of the coil. After moving the spark plugs into position near the specimen, a current of 55 amp. was passed through the heating coil. The time required for ignition was noted. Heating was continued for 30 sec. after the sample had ignited, and burning time was taken as that time required for the flame to extinguish itself after the coil was deenergized. Figure 1 shows the relation between the temperature at the specimen location and ignition time.

Results and Discussion

The data obtained by the three laboratories was gathered and arranged to facilitate comparison. The results of

[5] N. P. Setchkin, "Report on a Method and Apparatus for the Determination of Ignition Temperature of Plastics," *Report No. T. G. 3621-2*, Nat. Bureau Standards, (FP 2627) (June 17, 1948).

TABLE II.—IGNITION AND BURNING CHARACTERISTIC OF POLYESTER LOW-PRESURE PHENOLIC AND HIGH-PRESSURE MELAMINE FIBERGLAS LAMINATES.

Identification of Laminate	Bureau of Mines Laboratory				Material Laboratory N. Y. Naval Shipyard			National Bureau of Standards	
	Ignition Time, sec.	Burning Time, sec.	Ignition temperature, deg. Fahr.	Weight Loss, per cent	Ignition Time, sec.	Burning Time, sec.	Weight Loss, per cent	Flash Ignition Temperature, deg. Fahr.	Self Ignition Temperature, deg. Fahr.
A Polyester + 5 per cent Antimony Trioxide	61	324	671	16.1	71	301	18.6	671.0	874.4
B	67	283	833	16.5	96	239	16.3	676.4	845.6
C	78	138	674.6	12.7	74	160	11.2	741.2	836.6
D	58	372	762.8	16.0	72	354	20.5	665.6	811.4
E	60	41	584.6	6.1	77	41	6.0	687.2	910.0
F	58	303	852.8	12.7	100	362	18.8	710.6	887.0
G	199	43	1052.6	1.9	274	36	2.0	1004.0	1076.0
H	205	58	980.6	2.1	247	54	4.9	968.0	1059.8
I	Did not ignite[a]	...	1100+	9.1	600+ did not ignite	...	No data	887.0	1153.4

[a] Test terminated after 480 sec.

the tests are shown in Tables I and II.

From series of tests made at the Bureau of Mines, a detailed record of the nature of the burning of the laminates was made and is described as follows:

Laminate A (polyester + 5 per cent antimony trioxide).—It burned freely with smoky yellow flame that completely enveloped specimen and extended 4 to 6 in. above it. It did not smolder after extinction of flame. Considerable soot deposited in the chamber. X-ray spectrographic examination indicated the presence of antimony trioxide in both deposited and air-borne soot. The upper portion of the specimen was thoroughly carbonized after burning. Glass laminations separated in several places.

Laminate B (polyester, same as A but without antimony trioxide).—It burned freely with smoky yellow flame which deposited soot considerably. It did not smolder. The specimen was slightly swollen by separation of the glass lamination. The upper portion of the specimen was thoroughly carbonized.

Laminate C (polyester).—It burned with irregular smoky flame. There was considerable deposition of soot. The specimen did not smolder. The upper portion of the specimen was thoroughly carbonized and slightly swollen by separation of the glass laminations.

Laminate D (polyester).—It burned freely with smoky, yellow flame that completely enveloped the specimen. There was considerable soot deposition. The specimen did not smolder. The upper portion of the specimen was carbonized and slightly swollen with small cracks between glass laminations.

Laminate E (polyester).—It burned with an irregular, smoky flame. There was considerable deposition of soot. The specimen did not smolder. The upper portion of the specimen was somewhat carbonized and swollen by separation of glass laminations.

(by a stream of air) was such that the accumulated heavy vapors had an opportunity to be ignited by a pilot flame.

Concerning the relative rating of the plastic laminates, there was general agreement between the results of the Bureau of Mines and the New York Naval Shipyard. The new method of the National Bureau of Standards gave accurately determined values for ignition temperature. The Material Laboratory reported higher ignition temperatures than those reported by the Bureau of Mines and the former also reported shorter burning times than the latter. Weight loss values of both laboratories agree closely.

TABLE III.—RATING OF MATERIALS BY THREE LABORATORIES.

Identification of Laminate	Bureau of Mines Laboratory				Material Laboratory N. Y. Naval Shipyard			National Bureau of Standards	
	Ignition Time	Burning Time	Ignition Temperature	Weight Loss	Ignition Time	Burning Time	Weight Loss	Flash Ignition Temperature	Self Ignition Temperature
I Melamine	1	1	1	4	1	1	No data	3	1
H Phenolic	2	4	3	2	3	4	2	2	3
G Phenolic	3	3	2	1	2	2	1	1	2
C Polyester	4	5	7	5	7	5	4	4	8
B Polyester	5	6	5	8	5	6	5	7	7
A Polyester + Antimony Trioxide	6	8	8	7	9	7	6	8	6
E Polyester	7	2	9	3	6	3	3	6	4
D Polyester	8	9	6	6	8	8	8	9	9
F Polyester	8	7	4	5	4	9	7	5	5

Laminate F (polyester).—It burned with a large, luminous smoky flame. The center and upper portions of the specimen were thoroughly carbonized. Several cracks developed in the laminations.

Laminate G (phenolic).—It burned with a small luminous flame from one side of the specimen only. The specimen carbonized from the center only. There was slight shrinkage at the carbonized portion but no separation of laminations.

Laminate H (phenolic).—It burned with a small luminous flame that originated from the cut sides of the specimen and extended slightly above the top of the specimen. The specimen was carbonized only at the center portion. A slight shrinkage was evident at the carbonized portion but no cracks developed between laminations as the results of the test.

Laminate I (melamine).—Small jets of smoke and fumes emerged from certain points on the specimen. Some reached the spark plug electrodes and flamed momentarily. The resin exuded and the specimen charred; the gases that came off did not burn except for the observation noted. (Evidence of ignition of melamine in the tests conducted by the Bureau of Standards was noted as "Flame"; the characteristic of combustion was noted as "burns poorly.") In the Bureau of Standards tests, the rate of ventilation of the test chamber

Antimony trioxide did not significantly affect the burning characteristics. Actually, the polyester laminate without the inhibitor (laminate B) gave a slightly longer ignition time, a shorter burning time, and an ignition temperature which was 162 F. higher than laminate A (as determined by the Bureau of Mines). Laminate E had a very short burning time. Also its weight loss was comparatively small and its ignition temperature was lower than the other polyester laminates. Of the six polyester laminates tested, none exhibited good resistance to burning.

The data on the two phenolic laminates were in close agreement. From the Material Laboratory data it can be seen that laminate G resisted burning for 4½ min. and then burned for approximately 30 sec. losing only 2.0 per cent of its weight. Phenolic laminate H resisted burning for the same time and burned for about 56 sec., losing a maximum of 4.9 per cent of its weight.

The data on melamine are included to indicate the ignition and burning characteristics desired for a low-pressure laminate. These figures were considerably better than the results for the other laminates From Table II it is to be seen that the melamine did not ignite after being heated for longer than 480 sec. (Bureau of Mines), and for 600 sec. (Material Laboratory). Although the Bureau of Standards data indicated that the melamine of their tests ignited, the

flame was characterized as "burning poorly." The Flash Ignition Temperature and Self Ignition Temperature were 887 F. and 1153.4 F., respectively, as reported by the Bureau of Standards and these compared favorably with the values reported by the Bureau of Mines.

It is significant from Table III that the melamine and the phenolic laminates tested by the three laboratories rate in most cases in the first three categories out of a possible nine. This suggests that it might be possible to use the foregoing method to rate polyesters. The low weight loss of laminate E might be explained by the fact that it burned only 41 sec. and did not have time during burning to lose much weight.

Conclusions

The ignition and burning characteristics of the low-pressure polyester laminates tested were extremely poor in comparison to the melamine type. Antimony trioxide did not improve these qualities when it was added as an inhibitor to burning. The specific conclusions which are made on the basis of the results of the above-described tests are:

1. Melamines, having the greatest resistance to burning, the shortest burning times, and the highest ignition temperatures are, by far, better than the polyesters. Using the data on the melamine, partly as bases, the Bureau of Ships in order to approach its standards of good burning and ignition qualities, feels that a good plastic would exhibit properties as follows:

Ignition time	Would not ignite after 600 sec.
Burning time	30 sec. (preferably, it would not burn)
Weight loss	5 per cent or less after aging 8 hr. at 200 C.
Ignition temperature	1100 F. or higher
Per cent flexural strength retention after 8 hr. at 200 C.	50 per cent

2. The phenolics, in their ignition and burning characteristics, are much better than the polyesters but poorer than the melamines.

3. The polyesters, in the same qualities, are much poorer than either the melamines or the phenolics. To satisfy fully the requirements for resins to be used in mechanical applications by the Bureau of Ships, the polyesters should be of the nonburning type or at least self-extinguishing; they should be able to retain their strength to a high degree after being heated for reasonable lengths of time. If the polyesters are examined closely, the author believes many will agree that there is much room for improvement in the flame resistance of these polyesters. Such improvement would be welcomed by the Bureau of Ships and it should extend greatly their commercial applications in general.

4. It is also the opinion of the author that improvements must be made in the basic, resin molecular structure to produce low-pressure resin laminates having all the desirable fabrication characteristics of the presently used polyesters but also having equal or even superior ignition and burning qualities to both the phenolics and the melamines. New horizons will unfold for them in Naval applications when superior polyesters become available.

Acknowledgment:

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Nomograms for Obtaining the Compound Composition from the Oxide Analysis of Hydrated Limes

By Ernest M. Levin[1]

Synopsis

Two nomograms are presented for rapidly obtaining the compound composition of hydrated limes from the oxide analysis. The general nomogram can be applied to any commercial hydrated lime and gives values accurate to within 0.5 per cent. The special nomogram is applicable only to regularly hydrated and highly hydrated dolomitic limes and is accurate to within 0.3 per cent. The equations for calculating the compound composition are derived, and the significance of the unhydrated oxide content is stressed.

Hydrated limes can be classified broadly into three major groups on the basis of total magnesia content[2] as follows: (1) high-calcium, containing less than 5 per cent total magnesia, (2) dolomitic, containing more than 25 per cent magnesia, and (3) magnesian, containing between 5 and 25 per cent magnesia. Dolomitic limes can be further subdivided on the basis of the degree of hydration of the magnesia, as follows: regularly hydrated (also designated as normal hydrated lime)[3] in which the major portion of the magnesia has been left unhydrated, and highly hydrated,[4] (also designated as special hydrated lime, C 207[3]) in which the major portion of the magnesia has been hydrated.

Studies[5] have been in progress for several years at the National Bureau of Standards of a particular type of plaster failure, associated only with regularly hydrated dolomitic limes and characterized by the formation of bulges, or large blisters, in the white-coat. It has been found that this type of failure results from a delayed expansion of the

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] General Physical Scientist, National Bureau of Standards, Washington, D. C.

[2] Lansing S. Wells, Walter F. Clarke, and Ernest M. Levin, "Expansive Characteristics of Hydrated Limes and the Development of an Autoclave Test for Soundness," *Journal of Research*, Nat. Bureau Standards, Vol. 41, No. 3, September, 1948, pp. 179–205. (*RP* 1917.)

[3] Tentative Specification for Normal Finishing Hydrated Lime (C 6 – 46 T), 1946 Book of A.S.T.M. Standards, Part II, p. 1304; and Tentative Specifications for Hydrated Lime for Masonry Purposes (D 207 – 46 T), 1946 Book of A.S.T.M. Standards, Part II, p. 1308.

[4] Tentative Specifications for Special Finishing Hydrated Lime (C 2 6 – 46 T), 1946 Book of A.S.T.M. Standards, Part II, p. 1304.

[5] Lansing S. Wells, Walter F. Clarke, Edwin S. Newman, and Dorna L. Bishop, "Investigation of Failures of White-Coat Plaster," In Preparation as a Building Materials and Structures Report.

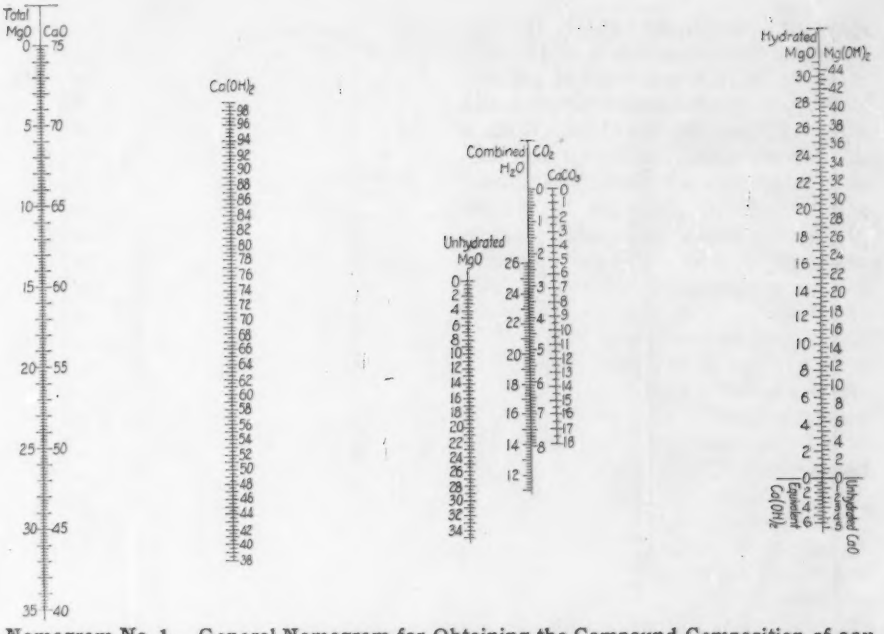
set, white-coat plaster. The regularly hydrated dolomitic lime that was mixed originally with the calcined gypsum and water to compound the wet plaster was not completely hydrated, and, consequently, the plaster contained unhydrated magnesium oxide (MgO) at the time of application. The unreacted MgO continues to hydrate slowly after the plaster has set, eventually causing the disruptive expansion of the white-coat.

As an outcome of these studies, the bureau assisted by other goverment agencies formulated a specification which would exclude partially hydrated dolomitic limes containing a high percentage of unhydrated oxides. Accordingly, the following tentative amendment to Federal Specification SS-L-351 for hydrated lime[6] is in effect: "The total free (unhydrated) calcium oxide (CaO) and magnesium oxide (MgO) in the hydrated product shall not exceed 8 per cent by weight calculated on the 'as-received' basis."

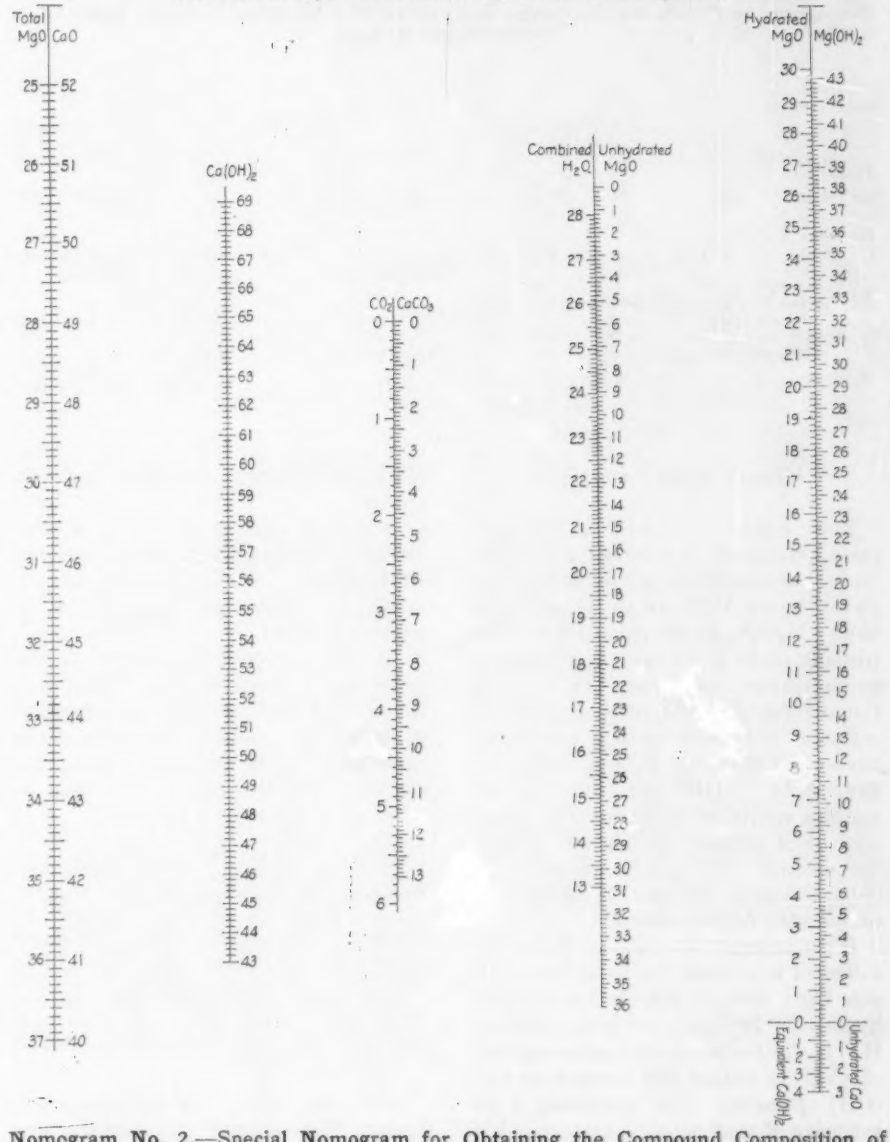
The 8 per cent limit of the unhydrated oxide in hydrated limes has been included in recent A.S.T.M. Specifications C 206 – 46 T[4] and C 207 – 46 T[3] and in those of the American Standards for Gypsum Plastering[7] where the requirements for hydrated lime to be used in white-coat plaster are given.

Numerous manufacturers of regularly hydrated dolomitic lime are producing at the present time a more completely hydrated lime which meets the 8 per cent maximum limit. In most instances the additional hydration is accomplished by treating the calcined limestone in an autoclave maintained at an elevated temperature and pressure. This type of lime has been referred to earlier in the paper as highly hydrated.

Determination of the unhydrated oxide content of a lime is of obvious importance in regard to the 8 per cent limit, both to the manufacturer and to the prospective purchaser of highly hydrated dolomitic lime. Investigations[8] carried on at the bureau have established a method for calculating the compound composition, including the unhydrated oxide content, from the chemical analysis. The chemical analysis includes determinations for "free" H_2O, combined H_2O, CO_2, SiO_2, R_2O_3, CaO, and MgO.



Nomogram No. 1.—General Nomogram for Obtaining the Compound Composition of any Commercial Hydrated Lime, from the Oxide Analysis.



Nomogram No. 2.—Special Nomogram for Obtaining the Compound Composition of Regularly Hydrated and Highly Hydrated Dolomitic Limes, from the Oxide Analysis.

[6] Proposed amendment to Federal Specification SS-L-351 for lime; hydrated (for) structural purposes. Date of amendment, February 2, 1940.

[7] Standard specifications for gypsum plastering including requirements for lathing and furring, American Standards Assn., A. 42.1-1946.

[8] Lansing S. Wells and Kenneth Taylor, "Hydration of Magnesia in Dolomitic Hydrated Limes and Putties," *Journal of Research*, Nat. Bureau Standards, Vol. 19, No. 2, August, 1937, pp. 215–235. (*RP* 1022.)

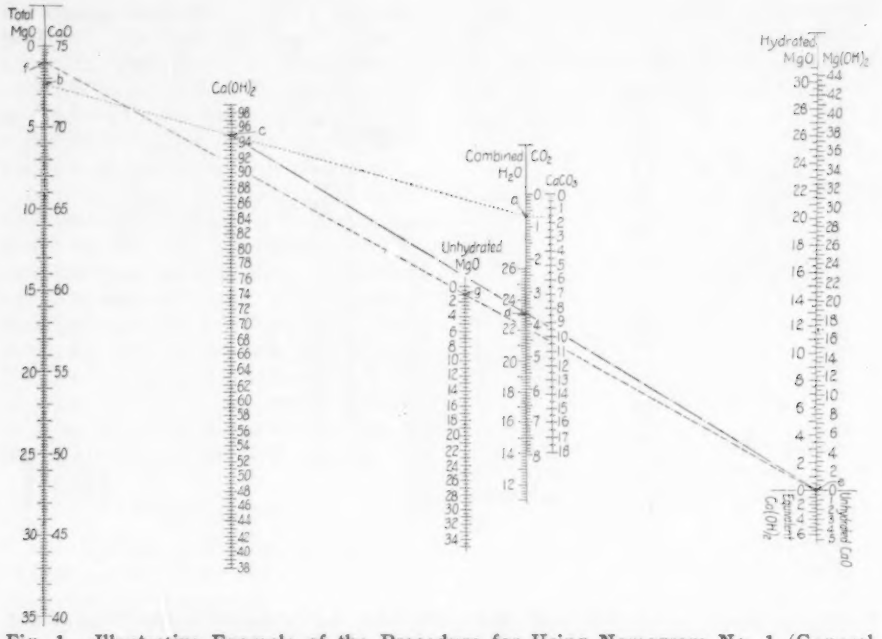


Fig. 1.—Illustrative Example of the Procedure for Using Nomogram No. 1 (General Nomogram) to Obtain the Compound Composition of a Hydrated Lime, as Applied to a High-Calcium Hydrate.

Oxide Analysis:

CO_2	0.70 per cent	"Free" H_2O	0.53 per cent
CaO	72.60 per cent	SiO_2	0.74 per cent
Combined H_2O	23.06 per cent	R_2O_3	0.60 per cent
Total MgO	1.04 per cent		
Subtotal	97.4 per cent	Subtotal	1.87 per cent
	TOTAL ..... 99.27 per cent		

Procedure:

1. Locate line *ab* (CO_2, per cent to CaO, per cent):	At right of point *a* read	$CaCO_3$	1.6 per cent
2. Locate line *cd* ($Ca(OH)_2$, per cent to combined H_2O, per cent) and extend to point *e* (hydrated MgO, per cent):	At point *c* read	$Ca(OH)_2$	95.0 per cent
3. Locate line *ef* ($Mg(OH)_2$, per cent to total MgO, per cent):	At point *e* read	$Mg(OH)_2$	0.0 per cent
	At point *g* read	unhydrated MgO	1.0 per cent
		Subtotal	97.6 per cent

Derivation of Equations

The method of calculating the compound composition is based essentially on the premise that CaO hydrates completely before MgO and then carbonates before MgO.[8] In the calculations, CO_2 (usually under 2 per cent) is allotted to an equivalent amount of CaO to obtain the amount of $CaCO_3$ present. The remaining CaO is allotted to an equivalent amount of combined H_2O to obtain the amount of $Ca(OH)_2$ present. The remaining combined H_2O is allotted to an equivalent amount of MgO to obtain the amount of $Mg(OH)_2$ present. Finally, the remaining MgO represents the unhydrated oxide content.

If the amount of combined H_2O is insufficient to account for all of the available CaO, some of the CaO is also unhydrated. In this event the combined H_2O is allotted to an equivalent amount of CaO to obtain the amount of $Ca(OH)_2$ present. The remaining CaO exclusive of that which is carbonated is unhydrated, and this value is added to the MgO to obtain the total unhydrated oxides.

It should be noted that in the calculations the SiO_2 and R_2O_3 are considered uncombined; but, fortunately, only a small percentage of these oxides is usually present.

In the following derivation of the percentage of unhydrated oxide in a lime, the formula for the oxide represents the percentage of that component present. Also, the derivation is carried out only for the most usual case in which all of the CaO is hydrated.

CaO equivalent to $CO_2 = 1.275\ CO_2$
CaO remaining = CaO $- 1.275\ CO_2$
Combined H_2O equivalent to CaO remaining = $0.3213\ (CaO - 1.275\ CO_2)$
Combined H_2O remaining = combined $H_2O - 0.3213\ (CaO - 1.275\ CO_2)$
Hydrated MgO = 2.238 [combined $H_2O - 0.3213\ (CaO - 1.275\ CO_2)$]
Unhydrated MgO (per cent) = total MgO $- 2.238$ [combined $H_2O - 0.3213\ (CaO - 1.275\ CO_2)$]

After the above calculations have been performed for determining the percentage of unhydrated oxide, the compound composition is obtained simply by addition or subtraction of the appropriate terms, as follows:

$CaCO_3 = CO_2 +$ (CaO equivalent to CO_2)
$Ca(OH)_2$ = (CaO remaining) + (combined H_2O equivalent to CaO remaining)
$Mg(OH)_2$ = (combined H_2O remaining) + (hydrated MgO)
Unhydrated MgO = (total MgO) − (hydrated MgO) (value obtained from the last step in the derivation)

The purpose of this paper is to present two nomograms from which the compound composition of a hydrated lime can be easily and rapidly determined from the oxide analysis, thus saving time and labor of calculation.

Description of Nomograms

The general nomogram (nomogram No. 1) is designed to give the compound composition of any commercial hydrated lime from the oxide analysis. It can be applied to limes of the high-calcium, magnesian, and dolomitic groups, with an accuracy of better than 0.5 per cent.

The special nomogram (nomogram No. 2) is designed so as to give values of the compound composition accurate to within 0.3 per cent, but the nomogram can be applied only to the regularly hydrated and highly hydrated dolomitic limes. Not only are the scale divisions in nomogram No. 2 larger than for nomogram No. 1, but also a better disposition of the scales, themselves, has been achieved.

Illustrative Examples

Figure 1 illustrates the method of using nomogram No. 1 for obtaining the compound composition of a hydrated lime, as applied to a high-calcium hydrate. The oxide analysis of the lime is given on Fig. 1.

On the scale for CO_2, locate the point *a*, corresponding to the value of 0.70 per cent. At the intersection of the horizontal projection from point *a* with the scale for $CaCO_3$, read the equivalent percentage of $CaCO_3$ (1.6). On the scale for CaO, locate the point *b*, corresponding to the value of 72.6 per cent, and lay a straightedge across the nomogram from *a* to *b*. At the intercept, point *c*, read the percentage of $Ca(OH)_2$ (95.0). On the scale for combined H_2O, locate the point *d*, corresponding to the value of 23.1 per cent. Lay the straightedge through points *c* and *d*, and locate the point *e* on the scale for hydrated MgO. On the adjacent scale, read the equivalent percentage of $Mg(OH)_2$ (0.0). On the scale for total MgO, locate the point *f*, corresponding to the value of 1.04 per cent, and lay the straightedge across the nomogram from *e* to *f*. Finally, at point *g*, the intersection of

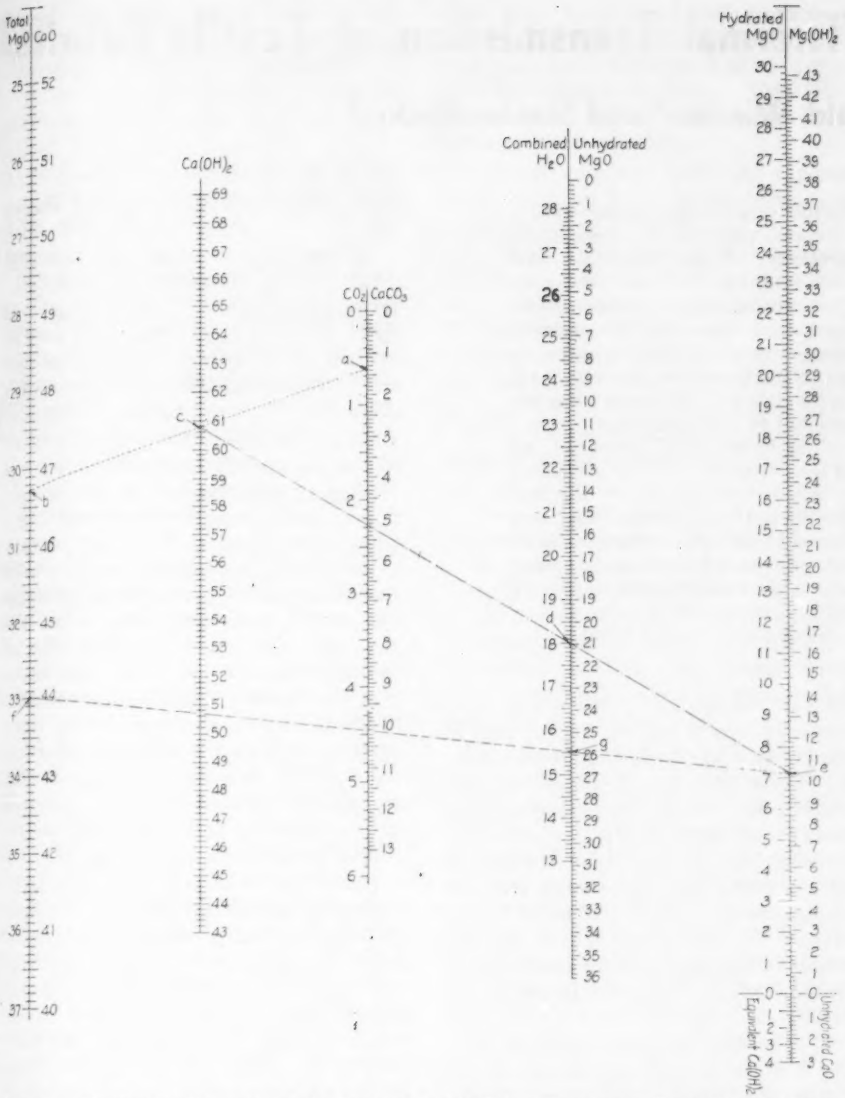


Fig. 2.—Illustrative Example of the Procedure for Using Nomogram No. 2 (Special Nomogram) to Obtain the Compound Composition of a Hydrated Lime, as Applied to a Regularly Hydrated Dolomitic Lime.

Oxide Analysis:

CO_2	0.63 per cent	"Free" H_2O	.30 per cent
CaO	46.72 per cent	SiO_2	0.94 per cent
Combined H_2O	17.96 per cent	R_2O_3	0.36 per cent
Total MgO	33.08 per cent		
Subtotal	98.39 per cent	Subtotal	1.60 per cent
	TOTAL 99.99 per cent		

Procedure:

1. Locate line *ab* (CO_2, per cent to CaO, per cent):	At point *a* read	$CaCO_3$	1.4 per cent
2. Locate line *cd* ($Ca(OH)_2$, per cent to combined H_2O, per cent) and extend to point *e* (hydrated MgO, per cent):	At point *c* read	$Ca(OH)_2$	60.7 per cent
3. Locate line *ef* ($Mg(OH)_2$, per cent to total MgO, per cent):	At point *e* read	$Mg(OH)_2$	10.4 per cent
	At point *g* read	unhydrated MgO	25.8 per cent
		Subtotal	98.3 per cent

the line *ef* with the scale for unhydrated MgO, read the percentage of unhydrated MgO (1.0).

Figure 2 illustrates the method of using nomogram No. 2 for obtaining the compound composition of a hydrated lime, as applied to a regularly hydrated dolomitic lime. The oxide analysis of the lime is given on Fig. 2.

On the scale for CO_2, locate the point *a*, corresponding to the value of 0.63 per cent. On the adjacent scale read the equivalent percentage of $CaCO_3$ (1.4). On the scale for CaO, locate the point *b*, corresponding to the value of 46.72 per cent and lay a straightedge across the nomogram from *a* to *b*. At the intercept, point *c*, read the percentage of $Ca(OH)_2$ (60.7). On the scale for combined H_2O, locate the point *d*, corresponding to the value of 17.96 per cent. Lay a straightedge through the points *c* and *d*, and locate the point *e*, on the scale for hydrated MgO. On the adjacent scale read the equivalent percentage of $Mg(OH)_2$ (10.4). On the scale for total MgO, locate the point *f*, corresponding to the value of 33.08 per cent, and lay the straightedge across the nomogram from *e* to *f*. Finally, at point *g*, the intersection of line *ef* with the scale for unhydrated MgO, read the percentage of unhydrated MgO (25.8).

To a certain extent the nomograms also provide for the unusual case in which the combined H_2O is insufficient to account for all of the available CaO, that is, none of the MgO is hydrated and some unhydrated CaO is present. For such a case, the point *e* (Figs. 1 and 2) on the appropriately established line *c-d-e* will be located on the two adjacent scales designated as unhydrated CaO and equivalent $Ca(OH)_2$. The unhydrated CaO value must then be added separately to the total MgO in order to obtain the total of unhydrated oxides. The reading on the $Ca(OH)_2$ scale must also be corrected by subtracting from it the $Ca(OH)_2$ equivalent of the unhydrated CaO.

Accuracy of the Nomograms

The reading error for nomogram No. 1, as published in this paper, is under 0.5 per cent and that for nomogram No. 2 is under 0.3 per cent. For greater accuracy large-sized nomograms are available as National Bureau of Standards Miscellaneous Publication M196.[9] The general nomogram (approximately 20 in. wide by 15 in. high) gives values accurate to within 0.3 per cent; the special nomogram (approximately 20 in. wide by 27 in. high) is accurate to within 0.1 per cent. The nomograms provide an accurate and rapid means for obtaining the compound composition of hydrated limes and should be especially helpful to the analyst making numerous routine determinations.

Acknowledgment:

I take pleasure in acknowledging my sincere appreciation to Marcella Lindeman Phillips, of the National Bureau of Standards, whose inspiring lectures on the subject of nomography motivated this work.

[9] Obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Measurement of the Thermal Transmission of Textile Fabrics[1]

By Gerald Winston[2] and Stanley Backer[2]

SYNOPSIS

Various techniques for measuring the thermal-transmission characteristics of textile fabrics were studied with the express purpose of developing a standard test for the evaluation of this property. A pilot interlaboratory investigation was first made on four materials, and this was later extended to 24 fabrics ranging in weight from 7 to 32 oz. per sq. yd. to permit a more adequate comparison of the thermal-transmission data with the physical properties of the fabrics. Each cooperating laboratory was requested to make thermal-insulation measurements according to its own method. All the techniques employed were based upon the principle of determining the energy required to maintain a body at a constant temperature when covered by the test specimen. Conditions of testing varied from laboratory to laboratory with little agreement in actual test values for similar groups of materials, but with excellent agreement in the rankings of the thermal transmission of the various fabrics. Of all the fabric properties, thickness evidenced the closest relationship with thermal insulation, indicating that for the present, thickness values should suffice to predict fabric performance on laboratory equipment designed to evaluate the thermal transmission of fabrics under still-air conditions. Consequently there is little point in conducting an all-out program of instrument standardization at this time.

PREVIOUS STUDIES

THE warmth of textile fabrics is without question the prime factor governing the type of clothing worn in temperate and arctic climates. So long as temperature differentials exist between the skin and the surrounding air, transfer of body heat will take place resulting in discomfort which is related to the rate of heat loss. In functioning as a resistor to heat flow, cloth behaves as do ordinary building materials in the conduction, convection and radiation of heat; however, the proximity of the warm moist skin imposes additional requirements on clothing materials which are not ordinarily considered by the mechanical engineer.

Listing of the factors which influence the transmission of heat by cloth is taken from the concepts of the building engineers (2).[3] *Radiation* is largely a surface phenomenon. The quantity of heat radiated from a hot body is proportional to the fourth power of its absolute temperature (in the case of a perfect radiator). A totally black body is a perfect radiator and also absorber of radiant heat. *Convection* refers to transfer of heat in a mobile medium by expansion and accompanying circulation of portions of the medium. Where the local source of heat is a solid, the problem is complicated by the formation of a barrier layer at the interfacial surface which offers fairly high resistance to transfer of heat energy. *Conduction* describes the flow of heat through a solid material with the energy transfer taking place between molecules themselves. Flow of this nature is proportional to the temperature drop across the material and to the reciprocal of the thickness.

Low-density materials such as textiles contain a large proportion of air within their total structures. Heat transmission through media of this type is therefore primarily dependent upon the resistivity of the air layer. The lower the proportion of fiber to air, the higher will be the resistance to heat flow of the cloth, and the limiting insulation is that of a layer of air equivalent in thickness to the textile material, assuming, of course, static conditions with no convection currents. In practice the chief function of the cloth is to trap an air layer (with high resistance), thus preventing circulation of air currents around the subject. Opposing requirements of high porosity (low density) and low permeability (negligible convection) are satisfied in combination fabrics consisting of a thick porous lining and a thin tightly woven outer cloth. Numerous investigations have led to this development and a few of these are reviewed to illustrate the general effect of fabric geometry on heat flow properties. More detailed information concerning the methods of measuring thermal conductivity is available in the reports on the work by Haven (10), Freedman (7) Black and Matthew (4), Marsh (13), Rees (15), Cleveland (5), and Baxter (3).

As has been indicated, the layer of dead air space in a textile material is of great importance in determining heat flow. Conditions of tests which tend to disturb this layer must be carefully controlled to prevent reflection of such variables in the test results. Included among these factors are molecules of air impinging against the fabric surface and tension or compression on the sample imposing a change in its geometric structure. Niven and Babbitt (14) investigated the effect of wind velocities on the thermal-insulating values of some clothing during wear and found that the tightness with which a combination of fabrics is worn is of more importance than the material. Tightness of textiles of low density is accompanied by compression and loss in thermal insulation value. This has been reflected in the complaints from army troops stationed in the north to the effect that winter "Long Johns" are poor insulators.

Rees (15) collected data on a large variety of fabrics of varied fiber content and demonstrated the dependence of heat loss upon one geometric consideration, that of thickness. In a similar comparison of weight *versus* heat loss he reported a general relationship to exist with points more widely scattered than in the thickness plot. Since increased thickness is generally accompanied by greater weight, this relationship is logical. It was also found that, in general, low-density fabrics have higher resistance than high-density materials, for in the denser fabrics the fiber conduction losses assume greater proportions. Increasing wind velocities during test caused greater heat losses in all cases, the low-textured materials undergoing the greatest change in heat flow. Single blankets which have relatively poor insulating qualities at high wind velocities are remarkably improved by addition of a light, tightly woven linen cloth. Finally, in the surface structure, smoothness *versus* roughness was noted to be a contributing factor in causing the initial chill or cold feel of fabrics when brought in contact with the skin.

Hock, *et al*, (11) showed the area of contact between fabric and skin to be a major factor contributing to the chilling effect of moist fabrics. The results of their experiments show progressive improvement of fabrics with respect to chilling as their wool content is in-

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Report of the Task Group on Thermal Transmission to Subcommittee B-1, A.S.T.M. Committee D-13, on Textile Materials.

[2] Statistician and Chief respectively, Textile Materials, Engineering Lab., Philadelphia Quartermaster Depot, Philadelphia 45, Pa.

[3] The boldface numbers in parentheses refer to the list of references appended to the paper.

creased, thus effecting a more lofty structure and rougher surface. The superiority of certain types of structures is evident. This work suggests a means for constructing a fabric with minimum chilling effect, namely, by use of unbalanced crimp and varied counts in the warp and filling directions to promote a ribbed effect with little contact surface area.

In a study of the properties of household blankets Schiefer, *et al* (16), confirmed the finding that thermal transmission of fabrics is independent of the kind of fiber. The reciprocal of thermal transmission was found to be related linearly to thickness as shown

$$\frac{1}{\text{Thermal Transmission}} = 3.0x + 0.63$$

where x is the thickness in inches at a pressure of 0.10 psi. and thermal transmission is expressed in Btu./(deg. Fahr. hr. sq. ft.).

Hamlin and Worner (9) studying 90 varying knit constructions showed thermal transmission to be inversely proportional to thickness and weight. They pointed out, however, that fabrics having a given weight can be made in a considerable range of thicknesses. In the fabrics constructed, thickness and weight are directly related, thus accounting for the correlation between weight and thermal values. Similarly the thicker fabrics are less permeable to air, and the data accordingly showed higher thermal transmission with higher air permeabilities even though the tests were conducted under static air conditions.

Fletcher (6) in her studies of knitted fabrics, treated the subject of thermal insulation in a manner similar to Schiefer's work. Plotting the reciprocals for thermal transmission against thickness, x at 0.1 psi., she obtained a straight line represented by:

$$\frac{1}{\text{Thermal Transmission}} = 3.85x + 0.61$$

and thermal transmission was expressed as Btu./(deg. Fahr.-hr. sq. ft.).

Relationships plotted by Baxter (3) show thermal-insulating values to be logarithmically related (approximately) to thickness up to 1 cm. Where materials exceed this thickness the rate of change of the slope of the thermal insulating value *versus* x curve falls off rapidly and appears to become horizontally asymptotic. Surface emissivity is shown to be of major importance in thin fabrics, but its effect diminishes as thicker materials (above 0.5 cm.) are considered. Surface losses are dependent on radiation and convection. The latter is a function of the geometric structure of the surface. Rough surfaces have lower heat losses than corresponding smooth surfaces. This difference is even more pronounced with increased wind velocities.

Goddard and Van Dilla (8) experimented with air layers to determine the feasibility of an inflatable sleeping bag pad. They found that air layers reach maximum insulation at ½ in. after which convection currents minimize the effects of increased thickness. Bounding materials make no difference in the values recorded except where open structures are used. Reduction of convection currents in the air layers is accomplished (with increased thermal insulating values) by inclusion of triangular-shaped baffles in the air space. Later reports by the Quartermaster Climatic Laboratories indicated successful increases of insulating values of air layers are obtained by inclusion of a minute amount of waterfowl down in the layer. This principle is used in experimental pads which are highly praised by users in the arctic and wet cold regions.

Larose (12) investigated the effect of closeness of weave and thickness upon thermal values of fabrics and showed that in winds up to 6 mph. there is little disturbance of the air behind a thin fabric covering a heavy pile material for air permeabilities up to 50 cu. ft per sq. ft. per min. at 0.5 in. of water. The sole effect up to this point is to change the resistance of the surface boundaries. From 6 to 30 mph. the reduction in thermal resistance is practically proportional to wind velocity for covers of low permeability. More permeable fabrics lose more thermal resistance in the range of 6 to 24 mph., then flatten off in the range of 24 to 30 mph. The open structure of the under layers of fabric is seen to affect thermal resistance when higher velocities are used with more permeable cover fabric. Variations in wind direction appear to affect thermal resistance in accordance with the magnitude of the perpendicular vector to the fabric surface. However, this relationship does not hold at low wind velocities. Larose also showed loss in thermal resistance as a result of a change in fabric thickness due to air pressure. All results reported for the fabric were corrected for boundary air resistance and compression due to wind pressure.

During 1942 and 1943 the Quartermaster Laboratory at Philadelphia had occasion to evaluate the relative thermal insulation of some 115 samples ranging in weight from lightweight flannels to heavy pile fabrics including both cotton and woolen materials. The physical properties of thickness, weight, density, and air permeability were tabulated and an attempt was made to relate the structure of the fabric to its warmth as measured on the laboratory apparatus. These studies revealed that thickness is the one property bearing a major relationship to thermal insulation. From the standpoint of heat losses through convection, it would seem that air permeability should also be an important characteristic affecting warmth. However, by utilizing multiple correlation techniques, the Philadelphia laboratory demonstrated that no improvement in the prediction of the thermal values of a fabric could be obtained through a consideration of its air permeability.

A.S.T.M. INVESTIGATIONS

As indicated above, technologists in England and the United States have developed numerous techniques for the measurement of the thermal transmission characteristics of textile fabrics. In general, the values reported by different laboratories for a given set of materials differed greatly. However, the fabrics were usually rated in the same order wherever significant differences between the test results were recorded. Variations in absolute values were caused by differences in conditions of measurement.

Series I

In October, 1944, a special committee was set up under Subcommittee B-1 on Test Methods, Section 1, of A.S.T.M. Committee D-13 on Textile Materials with the express purpose of developing a standard test for thermal transmission of textiles. Cooperative interlaboratory measurements made on four woolen materials early in 1944 served as the starting point for the committee program. A discussion of this first series of tests is included below:

	Fabric	Thickness (at 0.5 psi. pressure), in.
1.	Serge	0.065
2.	Arctic Serge	0.129
3.	Doeskin	0.135
4.	Fleece	0.265

Cooperating Laboratories:

1. Textile Section, National Bureau of Standards
2. R. H. Macy and Co.
3. Fabric Research Laboratories, Inc.
4. J. C. Penney Co.
5. Sears, Roebuck and Co.
6. United States Testing Co., Inc.
7. Philadelphia Textile Materials Engineering Laboratory (QMC).

Test Methods

1. *National Bureau of Standards.*—The equipment as described in the National Bureau of Standards *Research Paper RP 1055* (5), consistss of a "horizontal plate heated electrically and

maintained at constant temperature by means of a thermostat. The plate is surrounded by a guard plate which is also maintained at the same temperature to prevent lateral flow of heat into or out of the central test plate. A second guard heater is placed below the central plate to prevent the downward flow of heat. The specimen to be tested is laid flat without tension on the apparatus and inclosed in a copper hood placed several inches above it to eliminate the disturbing influence of air currents of the room. Since the thermostatic control results in an intermittent supply of heat to the central heater, an electric clock is added to the circuit, thus automatically adding the periods during which heat is being supplied. The difference in temperature from the central plate to the top of the hood is measured by means of a thermocouple and microammeter. The amount of heat supplied to the control heater per unit of time divided by the difference in temperature from the central plate to the hood and by the area of the hot plate is taken as a measure of the thermal transmission of the specimen." During the tests reported herein, the temperature of the hot plate varied from 50.1 to 52.5 C. while the hood temperature varied from 26.6 to 29.2 C. The difference in temperature between the hot plate and the hood varied from 21.7 to 23.9 C. The reported values, however, were corrected to read for a temperature gradient between plate and hood of 20 C. The heat loss when the apparatus was bare was 1.6 Btu. per hr. per sq. ft. per deg. Fahr.

2. *R. H. Macy and Co.*—In a paper given before the Society in 1930, Freedman (7) described a calorimeter device around which is wound the fabric specimen. The calorimeter consists of a cylindrical container measuring 10 in. in height and 3 in. in outside diameter and the wall encases the bulb of a xylene thermometer. This bulb is made of bronze tubing 0.090 in. in outside diameter and 400 in. long, wound helically on a cylinder of $\frac{1}{32}$ in. sheet copper. The spaces between convolutions are filled with lead so as to form a smooth outside surface. This gives a thermometric element with a total conducting surface of nearly 100 sq. in. The indicating instrument for this thermometer has a range from 90 to 110 F. with scale divisions of $\frac{1}{4}$ F. and is equipped with electric contacts for controlling the temperature within a narrow range. The thermometer is constructed for bulb immersion only and is compensated for atmospheric fluctuation along the line and at the instrument. The thermometer system is filled completely with xylene, the bulb being a capillary tube 0.008 in. in diameter. With increasing temperatures, the pressure rises, thus activating a coiled Bourdon spring in the instrument which in unwinding causes a pointer to move across the scale. An air duct is furnished for circulating air at controlled velocities past the calorimeter. A heater placed in the calorimeter maintains the temperature of the calorimeter at a predetermined point and the input wattage required for each test is determined by suitable measuring apparatus.

During the tests reported herein the four specimens were kept in the duct of the thermal transmission apparatus until temperature equilibrium was established. The calorimeter temperature was 98.7 F., the duct temperature 61.4 F., the average relative humidity 49 per cent, and the duct air velocity 4 mph.

3. *Fabric Research Laboratories, Inc.*—According to Mr. Hamburger, the apparatus used in the measurement of conductance of the fabrics submitted consists of a heat source in the form of a calorimeter kept at 100 C. by boiling water and a receiver in which is embedded a copper-constantan thermocouple which is connected in series with a second copper-constantan thermocouple maintained as nearly at room temperature as possible. The copper black body containing the receiver thermocouple is brought to temperature equilibrium with the constantan couple by observing a zero reading on the galvanometer. This device is a modification of the Cenco-Fitch apparatus and permits the use of rectangular coordinates in plotting the data. The constantan is obtained by the following formula:

$$\text{Constantan} = \frac{\text{Mass (g.)} \times \text{Specific Heat} \times \text{Temperature Rise (deg. Cent.)}}{\text{Area (sq. M)} \times \text{Temperature Differential (deg. Cent)} \times 60 \text{ (sec.)}}$$

The temperature rise in the above formula is indicated by the deflection of the galvanometer, and, in the case of the tests described herein, represents a direct relationship of deflection to temperature in degrees Centigrade.

4. *J. C. Penney Co.*—According to Mr. Dorn the apparatus used in measuring the insulation values of the fabrics submitted consists of an icebox which is maintained during test at a temperature of 30 F. This box is provided with an electric fan which circulates a current of air during test, but in such a manner that the air does not strike directly on the sample, but rather flows along its surface. Suspended in this box is a copper cylinder which is insulated for a 2-in. space at each end. Inside the cylinder is a heating bulb and a thermostat. During the test, the temperature of this cylinder is maintained accurately at body heat. The cylinder is first calibrated to find the amount of current required to keep it at body temperature for a period of 1 hr. with the box maintained at 30 F. The cylinder is then covered by the material to be tested and a similar determination is made. The difference in current consumption required to keep the cylinder at a constant temperature when exposed and when protected by the test specimen is used as a basis for calculating the insulation afforded by the material.

5. *Sears, Roebuck and Co.*—According to Miss Pratt, the Sears, Roebuck device is similar to the Bureau of Standards machine except that a larger test area is used and the temperature is controlled by different means. The apparatus is normally maintained at 170 ± 1 F., giving a temperature difference of 100 F. and eliminating errors due to fabric irregularities or temperature fluctuation of the plate or conditioning room. In using this high temperature, the fabric is practically dry while being tested. The test results are obtained with a flat, guarded hot-plate device. The receiver of the heat, or cold point, is the air in the constant-temperature room which was kept at 70 ± 2 F. and at a relative humidity of 65 per cent. The hot plate of the device is kept either at 100 ± 2 F. or at 50 ± 2 F. above the room temperature. The area of the test plate, which measured 1 by 2 ft. eliminated any possible effects of fabric irregularities on the test. The air currents in the room are too small to be measured with an anemometer and the test can be called a "still-air test."

6. *The United States Testing Co.*—According to Mr. Monego of Forstmann Woolen Company, who arranged for these tests, the equipment used by the U. S. Testing Co. is of similar design to that used by the National Bureau of Standards. In addition there is provided facility for blowing a 12 mph. wind perpendicular to the hot plate.

7. *Philadelphia Textile Materials Engineering Laboratory.*—The apparatus used at the Quartermaster Laboratory in Philadelphia includes a large upright cylinder, 2.5 ft in circumference and 3.25 ft. in height, containing oil maintained at 98.6 F., or normal body temperature. The electric energy required to maintain the oil bath at the constant temperature when the entire apparatus is inclosed in a cold room at 38 F. was the basis for comparison of the insulating characteristics of fabrics covering the cylinder.

Results and Discussion:

It is evident in the description of the equipment that conditions of meas-

TABLE I.—THERMAL TRANSMISSION MEASUREMENTS OF FOUR WOOLEN MATERIALS BY SEVEN LABORATORIES.[a]

Laboratory	Test Conditions	Original Units or Name of Quantity Measured	Material Tested: Fleece		Doeskin		Arctic Serge		Serge	
			Lab. Units	Comparison Units[b]	Lab. Units	Comparison Units[b]	Lab. Units	Comparison Units[b]	Lab. Units	Comparison Units[b]
No. 1	.....	Btu. per Hr. per Sq. Ft. per deg. Fahr.	0.95	0.95	1.22	1.22	1.19	1.19	1.52	1.52
No. 2	.....	Watts per Sec. per Sq. Ft. per deg. Fahr.	0.31	1.49	0.49	2.41	0.49	2.41	0.65	3.20
No. 3	.....	Cal. per Sec. per Sq. Meter per deg. Cent.	3.38	2.49	5.61	4.14	7.20	5.31	11.00	8.12
No. 4	.....	Thermal Insulating Value[c]	34.9	..	21.20	..	18.80	..	14.90	..
No. 5	(Temp. Gradient 100 F. (above room temp.) Mean Temp. 120 F.	Warmth Coefficient	1.06	0.94	0.93	1.08	0.84	1.19	0.64	1.52
	Temp. Gradient 50 F. (above room temp.). Mean Temp. 95 F.		1.15	0.87	0.85	1.18	0.79	1.27	0.66	1.52
No. 6	(Still Air	Btu. per Hr. per Sq. Ft. per deg. Fahr.	1.05	1.05	1.48	1.48	1.47	1.47	1.58	1.58
	12 Mph. Wind Perpendicular to Test Plate		1.40	1.40	2.08	2.08	2.20	2.20	2.70	2.70
No. 7	(2.3 Mph. Wind Across Cylinder	Relative Thermal Resistance	3.24	1.14	2.43	1.51	2.43	1.51	1.96	1.88
	Still Air		2.30	0.98	1.53	1.26	1.62	1.22	1.44	1.38

[a] Face of fabric away from heat source. [b] Btu. per Hr. per Sq. Ft. per deg. Fahr. [c] Value not convertible to comparison units.

TABLE II.—COMPARISON OF THICKNESS AND THERMAL VALUES OF 24 WOOLEN FABRICS AS REPORTED BY FIVE LABORATORIES.

Fabric	Thickness at 0.5 psi. Pressure		Philadelphia Quartermaster Depot: Relative Thermal Resistance		Climatic: clo		Sears: Warmth Coefficient		Penney: Insulation, per cent		Macy's: watts per deg. Fahr.	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank[b]
1. Barathea	0.030	4	1.84	2	0.73	4	0.543	3.5	14.28	4	0.625	4
2. Barathea	0.034	7	1.89	3	0.72	2.5	0.533	1	12.25	1	0.640	3
3. Covert	0.033	5.5	2.04	9	0.76	6.5	0.584	6	18.16	7	0.594	7
4. Elastique	0.038	9	1.95	6	0.72	2.5	0.543	3.5	20.58	11	0.598	6
5. Serge	0.036	8	2.01	7	0.78	9.5	0.594	8	26.88	16	0.566	9
6. Serge	0.043	11	2.16	11	0.80	11.5	0.618	9.5	22.40	14	0.513	15
7. Gabardine	0.028	2.5	1.93	4	0.74	5	0.586	7	16.83	6	0.641	2
8. Tropical	0.02[illegible]	1	1.80	1	0.70	1	0.540	2	13.80	3	0.688	1
9. Covert	0.048	13	2.28	14	0.80	11.5	0.650	13	21.19	12	0.543	11
10. Doeskin	0.060	15	2.34	15	0.82	14.5	0.686	15	21.80	13	0.523	14
11. Facing	0.044	12	2.19	12	0.78	9.5	0.621	11	19.17	8	0.560	10
12. Flannel	0.040	10	2.14	10	0.77	8	0.841	12	19.67	10	0.573	8
13. Melton	0.061	16	2.52	16	0.89	16	0.760	16	24.94	15	0.431	16
14. Melton	0.091	17	2.77	17	0.96	17	0.759	17	27.59	17	0.386	17
15. Lining napped	0.127	19	3.41	19	1.28	19	1.085	21	38.86	19	0.298	19
16. Lining napped	0.033	5.5	2.03	8	0.82	14.5	0.618	9.5	15.18	5	0.532	12
17. Lining napped	0.028	2.5	1.94	5	0.76	6.5	0.572	5	12.62	2	0.623	5
18. Lining napped	0.050	14	2.27	13	0.81	13	0.676	14	19.43	9	0.531	13
19. Lining napped	0.141	20	3.72	20	1.33	20	1.077	19	40.59	21	0.289	21
20. Lining napped	0.157	22	3.91	22	1.34	21	1.082	20	42.69	23	0.242	24
21. Lining napped	0.191	24	4.17	24	1.50	24	1.234	24	41.00	22	0.255	23
22. Lining napped	0.098	18	3.21	18	1.14	18	0.921	18	37.19	18	0.348	18
23. Lining napped	0.149	21	3.94	23	1.40	22	1.110	23	39.90	20	0.293	20
24. Lining napped	0.169	23	3.88	21	1.44	23	1.105	22	42.73	24	0.270	22
	ρ^a		0.97		0.92		0.94		0.9[illegible]		0.95	

[a] Spearmans Rank Correlation Coefficient Between Thickness and Thermal Values.
[b] Ranked from highest to lowest for purpose of comparability since Macy's is the only one that reported thermal transmission.

urement varied within the laboratories. The data obtained are shown in Table I both in the original units of measurements and in Btu. units to which the original units were converted for purposes of comparison.

Conversion of the data to a common unit of measurement where possible hardly provided the absolute agreement hoped for, but consistency in ranking the four materials with respect to thermal transmission was noted. The relationship between thickness and Btu. per hr. sq. ft. per deg. Fahr. was confirmed in these cases where units of measurement were so reducible. Factors which contributed to differences in absolute measurements included: (1) motion of wind during test, (2) use of varied temperature levels and gradients on which depends the proportion of radiation loss to over-all heat loss, (3) varied conditions of relative humidity during the thermal tests, and (4) sample orientations, that is, tension or compression during measurements. The data at hand did not warrant establishing the relationship between the absolute values reported by the various laboratories and the specific conditions of test.

Series II

It was decided to expand the range of materials tested to provide for a more adequate comparison of the thermal-transmission data with the physical properties of the fabrics. Twenty-four fabrics ranging from 7 oz. to 32 oz. per linear yard (56 in. wide) were distributed to cooperating laboratories with the request that thermal measurements be conducted according to the exact method utilized by each laboratory in its standard tests. The data were returned to the Quartermaster Textile Materials Engineering Laboratory at Philadelphia for consolidation and summary. The results of this second series of interlaboratory tests are presented in Table II.

Cooperating Laboratories:

1. R. H. Macy & Co.
2. Sears, Roebuck & Co.
3. J. C. Penney Co.
4. Philadelphia Quartermaster Textile Materials Engineering Laboratory
5. Quartermaster Lawrence Climatic Research Laboratories.

Test Methods:

The equipment used to evaluate the fabrics of Series II by the Macy, Sears, Penney, and the Philadelphia Quartermaster laboratories, respectively, was the same as that used for Series I. The instrument used at the Quartermaster Lawrence Climatic Research Laboratories is a modification of the guarded-plate method developed at the Bureau of Standards and consists of a guard-ring brass cylinder 3½ in. in diameter. According to Mr. Talbot the cylinder is mounted in a constant-temperature room maintained at 70 F. and a relative

humidity of 50 to 65 per cent. The cylinder temperature is 95 F. There was no forced air movement. The air film resistance is 0.55 clo[4] and is included in the clo values in Table II. It is thus necessary to subtract 0.55 clo from the tabulated clo values to obtain intrinsic fabric insulation. However, in comparing the relative values furnished by the majority of the laboratories this correction was omitted. A further correction factor was recommended in comparing thermal-insulating values as measured on a cylinder with those measured on a flat plate. This correction is negligible for thin fabrics but amounts to about 0.1 clo for the napped lining of thickness 0.191 in.

In tests at the Philadelphia laboratory the outside room is maintained at +40 F. and 80 per cent relative humidity and an air current of 0.5 mph. is directed against the cylinder. To insure rigid adherence to the test conditions a control sample is interspersed at regular intervals during the testing of the 24 woolen materials and the averages and ranges of groups of four control tests are plotted according to A.S.T.M. Standards (1). The apparatus was seen to be in control during the entire run.

In the tests conducted at Sears, Roebuck and Co. the measurements were made using a 100 F. temperature difference between room and hot plate. Still air conditions were provided.

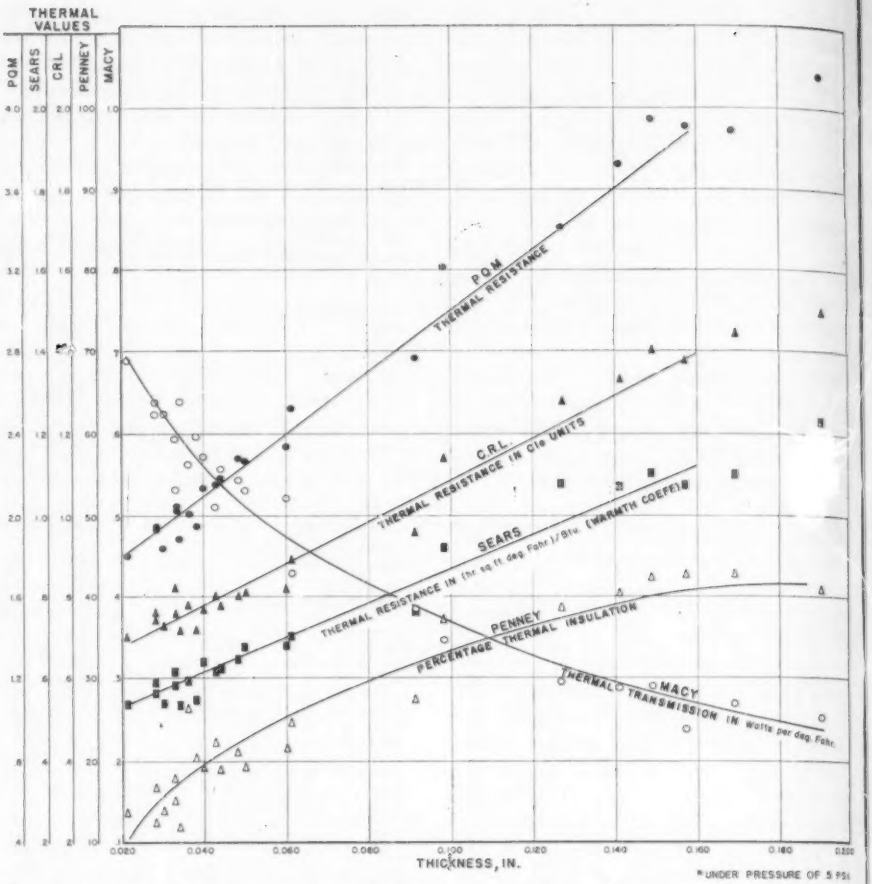


Fig. 1.—Relationship Between Thermal Values and Thickness (Under Pressure of 0.5 psi.) of 24 Fabrics as Evaluated by Five Laboratories.

Results and Discussion

Thickness data of the 24 materials are presented in Table II together with the results of thermal tests at the several laboratories. Of numerous properties studied only thickness evidences a high relationship with thermal insulation values. This result is in agreement with the findings of the 1942–1943 studies.

The high association existing between the thickness values and the corresponding thermal values is illustrated in Fig. 1. When the thermal values for each laboratory are ranked from the lowest 1 to the highest 24 in Table II, the remarkably high consistency becomes evident regardless of the laboratory or the instrumentation. An analysis of variance of these ranked data shows a highly significant difference existing in the warmth of the fabrics, and the probability of their being ranked fortuitously is less than one in ten thousand.

Conclusions

It has been indicated that conditions of testing the thermal transmission of textile materials vary from laboratory to laboratory throughout the country. As a result, little agreement is had in absolute test values submitted for the same group of materials. Comparative results, however, show remarkably high agreement among laboratories.

Under the conditions of measurement practiced by the cooperating laboratories the thermal transmission values reported are directly related to fabric thickness and therefore are affected by all factors which influence fabric thickness. Present thermal measurements in the field of textiles fall into three categories for flat plate tests:

1. Direct measurement of heat transfer through the fabric under specific conditions, expressing the results in units of heat lost per degree temperature difference in a unit time over a unit area. Here the thermal index or rate of loss, c, is a function of thickness, x, for fabrics less than 0.5 in. in thickness

$$c = \frac{1}{ax + b}$$

where a and b are constants (see Macy data Fig. 1).

2. Direct measurement of the rate of heat loss with the reciprocal of same used as the index of thermal resistance, R. Here the index of resistance is related linearly to thickness for fabrics of commercial construction up to 0.5 in. Within the ranges of commercial colors, dyed and undyed textiles adhere closely to the relationship

$$R = ax + b$$

where a and b are constants (see PQM, CRL, and Sears data, Fig. 1).

3. Measurements of relative heat loss through a fabric where such measurements are expressed percentagewise in terms of an arbitrary rate of loss, such as loss from the uncovered test equipment. This index is termed relative Thermal-Insulation Value (T.I.V.) and is the following function of thickness for fabrics up to 0.5 in. in thickness:

$$\text{T.I.V.} = \frac{c'(ax + b) - 1}{c'(ax + b)}$$

where x is the fabric thickness, c' the heat loss from the uncovered test plate, and a and b are constants (see Penney data, Fig. 1).

Review of these relationships makes it evident that until such time that other conditions are included in thermal tests on the basis of correlation with actual field exposures, for example humidity and simulated perspiration (especially

[4] One clo is the insulation required to maintain in comfort a sitting resting subject at 70 F., air movement 20 ft. per min., and humidity not greater than 50 per cent.

important in the case of lightweight tropical fabrics), wind conditions, and solar radiation, there appears to be little point in conducting an all-out program of instrument standardization. Thickness values should suffice for the present in predicting fabric performance on the laboratory equipment designed to evaluate thermal transmission of textiles under still-air conditions, where the fabric under test has not been subjected to dye or other treatment which would, *per se*, alter its normal radiation characteristics. Too, with the possible development of new synthetic fibers and fabric constructions designed for service under extreme climatic conditions, thickness as the chief criterion of thermal characteristics may possibly be relegated to a position of less prominence.

BIBLIOGRAPHY

(1) American Standards Association, Guide for Quality Control and Control Chart. Method of Analyzing Data (1941).

(2) J. R. Barned, "Thermal Conductivity of Building Materials," *Report No. R2*, Australian Council for Scientific and Industrial Research (Wartime) (Unpublished).

(3) S. Baxter, "Thermal Conductivity of Textiles," *Proceedings* Phys. Soc., Vol. 58, pp. 105–118 (1946).

(4) C. P. Black and J. A. Matthew, "The Physical Properties of Fabrics in Relation to Clothing," *Journal Textile Inst.*, Vol. 25, p. T197 (1934).

(5) R. S. Cleveland, "An Improved Apparatus for Measuring the Thermal Transmission of Textiles," *Journal of Research*, National Bureau of Standards, Vol. 19, December, 1937, pp. 675–684. (*RP* 1055.)

(6) H. M. Fletcher, "Physical Properties of Knitted Fabrics Made of Natural and Mercerized Carded and Combed Cotton Yarns," *Rayon Textile Monthly*, Vol. 26, pp. 233–236 (1945).

(7) E. Freedman, "Thermal Transmission of Fabrics," *Proceedings*, Am. Soc. Testing Mats., Vol. 30, Part II, p. 1025 (1930).

(8) W. L. Goddard and M. Van Dilla, "Air Layers, Thermal Properties When Bounded by Surfaces of High and Low Emissivity," *Reports No. 4589, 4590*, Climatic Research Laboratories (USA), December 1945 (Unpublished).

(9) C. H. Hamlin and R. K. Worner, "Properties of Knit Underwear Fabrics of Various Constructions," *Journal of Research*, National Bureau of Standards, Vol. 13, September, 1934 p. 311, (*RP* 711.)

(10) G. B. Haven, "Mechanical Fabrics," John Wiley & Sons, Inc., New York, N. Y., p. 260 (1932).

(11) C. W. Hock, A. M. Sookne, and M. Harris, "Thermal Properties of Moist Fabrics," *Journal of Research*, National Bureau of Standards, Vol. 32, May, 1944, p. 229. (*RP* 1587.)

(12) P. Larose, "The Effect of Wind on the Thermal Resistance of Clothing with Special Reference to the Protection Given by Coverall Fabrics of Various Permeabilities," *Canadian Journal of Research*, Section A, Vol. 25, pp. 169–190, July, 1947.

(13) M. C. Marsh, "The Thermal Insulating Properties of Fabrics," *Journal Textile Inst.*, Vol. 22, pp. T245–273 (1931).

(14) C. D. Niven and J. D. Babbitt, "On the Heat Transmission of Textile Fabrics," *Journal Textile Inst.*, Vol. 29, pp. T161–172 (1938).

(15) W. H. Rees, "The Transmission of Heat Through Textile Fabrics, *Journal Textile Inst.*, Vol. 32, pp. T149–165 (1941).

(16) H. F. Schiefer, H. T. Stevens, P. B. Mach, and P. M. Boyland, "Study of the Properties of Household Blankets," *Journal of Research*, National Bureau of Standards, Vol. 32, June, 1944, pp. 261–284. (*RP* 1589).

Discussion of Paper on Visual Rating of Rusted Steel Specimens[1]

MR. J. C. HUDSON.[2]—I have read with interest the article by Harry L. Faigen. As this is a matter of importance to all engaged in corrosion work, I think it may prove helpful if I describe briefly the procedure adopted by my laboratory.

We are concerned mainly with assessments of the breakdown of protective paint films applied to structural steel. The experimental work, which is conducted by our Protective Coatings Subcommittee in collaboration with the official organizations of the British paint industry, is organized and controlled by our Joint Technical Panel J/P1—Paints for Structural Steelwork. After much experience on the inspection of painted steel test specimens exposed to field tests in the open air, the Panel has adopted a standard inspection schedule on which the following observations are recorded:

General appearance of the paint film, chalking and cracking.—Each of these is reported on a qualitative basis as one of three grades.

Discoloration, blistering, flaking, and rusting.—In each case, the percentage of the surface affected is estimated. Moreover, in the case of blistering and flaking, the general size of the failures is also indicated thus:

f, fine.....	less than 2 mm. diam.
m, medium	2 to 10 mm. diam.
c, coarse...	more than 10 mm. diam.

Further details of the definitions of the terms concerned and of the methods of assessment will be given in the Second Interim Report of Joint Technical Panel J/P1, which it is hoped will be available in January, 1950. The interesting point to be noted now is that the Panel has decided that, for practical purposes, the most important criterion of failure is the degree of rusting of the basis steel. We have prepared standards representing 0.1, 0.2, 0.5, 1, and 2 per cent of rusting, which are reproduced in the accompanying Fig. 1. These are photographs at natural size of 8 sq. in. of actual specimens; in each case, the total area, where the paint film has been disrupted by rust as distinct from merely stained by rusting, was computed by several observers and the average value corresponds to the percentage of rusting given.

We consider that, in good practice, a painted steel surface in the condition corresponding to 0.2 per cent rusting has reached the stage at which repainting is desirable and that 0.5 per cent rusting represents a stage at which repainting is overdue. Consequently, in all probability, the final reports on our experimental work will be based on statements of the durations of exposure after which the various protective schemes had reached one or both of these degrees of rusting.

Thus, our method of assessing rusting is rather more simple than that of Mr. Faigen. Complications due to the fact that the degree of rusting varies over a large surface are overcome by subdividing the specimen into a number of sub-areas and making separate estimates for each. In addition, we realize that importance must be attached to other types of breakdown, particularly the development of medium and coarse blisters produced by subjacent rust; and we naturally pay attention to such observations when distinguishing between specimens that have suffered an equal degree of rusting.

MR. HARRY L. FAIGEN (*author's closure*).—The procedure for assessing the performance of paint films applied to structural steel, described by Mr. J. C. Hudson, is both informative and direct, and should prove helpful for those confronted with similar problems of inspection.

Joint Technical Panel J/P1 appears mainly concerned with a narrow segment in the spectrum of rusted surface appearance. Fortunately, too, the particular range of rusting involved lends itself to direct percentage estimation of surface area rusted, so that the percentages themselves can constitute ratings.

[1] Harry L. Faigen, "A Visual Rating System for Rusted Steel Specimens," ASTM BULLETIN, No. 154, October, 1948, p. 39 (TP197).

[2] Head of the Corrosion Laboratory, British Iron and Steel Research Assn., Birmingham, England.

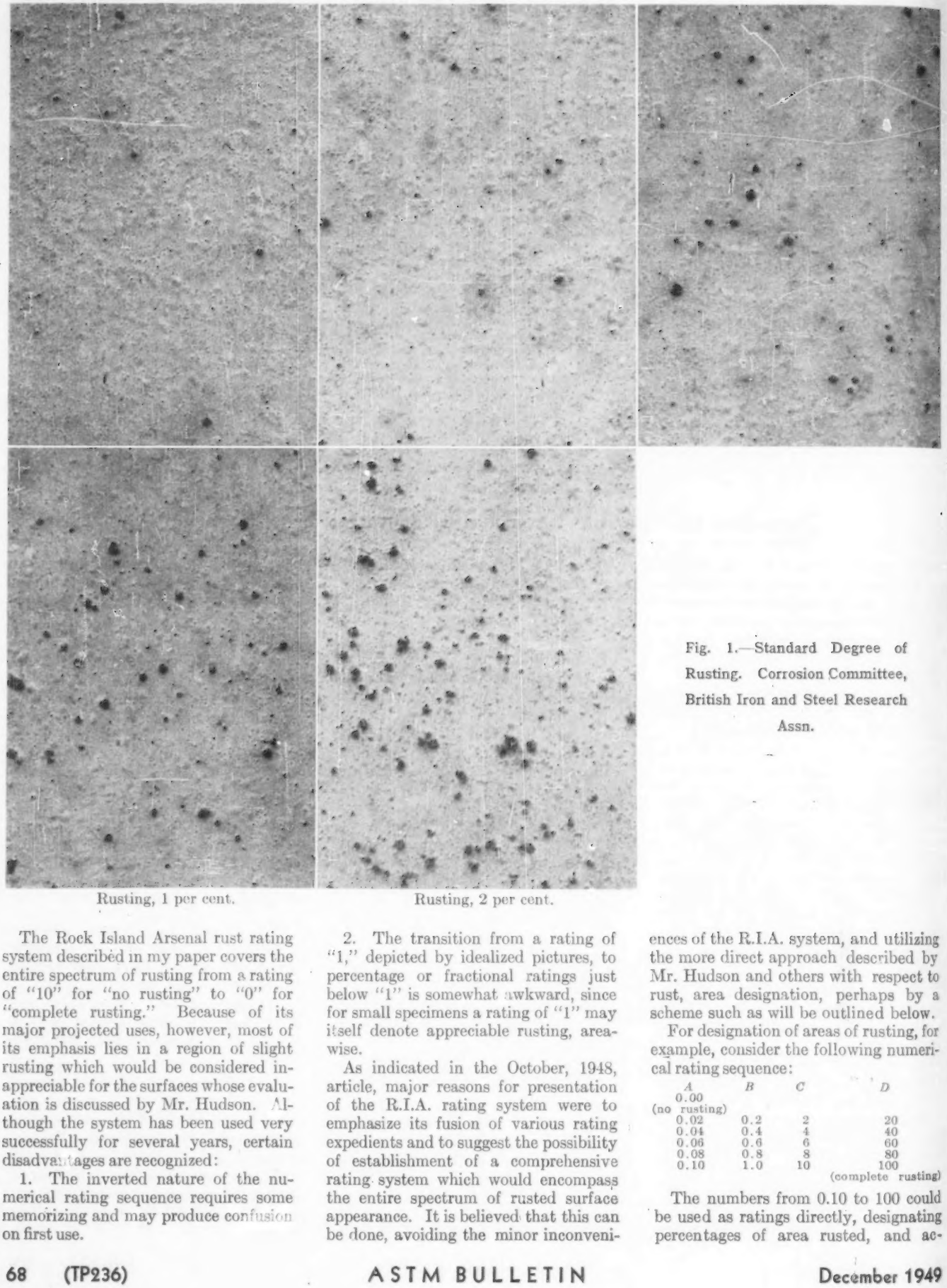


Fig. 1.—Standard Degree of Rusting. Corrosion Committee, British Iron and Steel Research Assn.

The Rock Island Arsenal rust rating system described in my paper covers the entire spectrum of rusting from a rating of "10" for "no rusting" to "0" for "complete rusting." Because of its major projected uses, however, most of its emphasis lies in a region of slight rusting which would be considered inappreciable for the surfaces whose evaluation is discussed by Mr. Hudson. Although the system has been used very successfully for several years, certain disadvantages are recognized:

1. The inverted nature of the numerical rating sequence requires some memorizing and may produce confusion on first use.

2. The transition from a rating of "1," depicted by idealized pictures, to percentage or fractional ratings just below "1" is somewhat awkward, since for small specimens a rating of "1" may itself denote appreciable rusting, areawise.

As indicated in the October, 1948, article, major reasons for presentation of the R.I.A. rating system were to emphasize its fusion of various rating expedients and to suggest the possibility of establishment of a comprehensive rating system which would encompass the entire spectrum of rusted surface appearance. It is believed that this can be done, avoiding the minor inconveniences of the R.I.A. system, and utilizing the more direct approach described by Mr. Hudson and others with respect to rust, area designation, perhaps by a scheme such as will be outlined below.

For designation of areas of rusting, for example, consider the following numerical rating sequence:

A	*B*	*C*	*D*
0.00 (no rusting)			
0.02	0.2	2	20
0.04	0.4	4	40
0.06	0.6	6	60
0.08	0.8	8	80
0.10	1.0	10	100 (complete rusting)

The numbers from 0.10 to 100 could be used as ratings directly, designating percentages of area rusted, and ac-

companied by actual or idealized pictures. If the former, pictures such as those presented by Mr. Hudson, which appear excellent, could be directly adapted to the appropriate ratings. The numbers smaller than 0.10 in column *A* could be used as designations, *per se*, without meaning as regards percentages of area, to designate very slight degrees of rusting by a counting or idealized picture technique such as that of the R.I.A. method, replacing ratings 10 to 3 of that system. Agreement would have to be reached on some unit of specimen surface area for pictorial representation. Pictures would not be required for the ratings in column *D* and probably would not be required for all of the ratings in columns *B* and *C*. The pictorial representation of strategic rating levels could be decided on the basis of those most pertinent or necessary in various fields of inspection.

For the "nature of rusting or surface appearance" term, a glossary of abbreviations to designate observations such as rust dots, spots or areas, chalking, cracking, discoloration, blistering, flaking, etc., can be established. These might be followed by or combined with intensity designations as in the two systems under discussion here.

The projected second Interim Report of Joint Technical Panel J/P1, as well as further developments regarding rust rating systems in A.S.T.M. Committee B-8, Subcommittee I on Specifications, Papers and Definitions, will be awaited with great interest by those active in related fields.

Spectrographic Methods for Determining Magnesium in Nodular Iron

By Ford R. Bryan,[1] G. A. Nahstoll,[2] and H. D. Veldhuis[2]

RECENT advances toward the production of magnesium-treated nodular graphite cast iron have indicated the need for a rapid method of analyzing iron for magnesium. The low concentrations of magnesium involved suggest the adoption of a spectrographic method from the standpoint of both speed and accuracy of analysis. Since spectrographic control analysis of cast iron by spark excitation of metallic samples is well established for many elements (1–5),[3] it is advantageous to utilize as much as possible of the same general procedure for the determination of magnesium.

A series of solid metal samples of known magnesium content with which to calibrate an analytical working curve is required for a typical metallic electrode method for cast iron. Since analyzed standards for magnesium in iron are not readily available, a procedure employing synthetic solutions was used to develop a group of metallic standards.

A satisfactory magnesium determination is dependent on the presence of sufficiently sensitive magnesium lines within the wave-length range customarily employed for iron analysis and freedom of one or more of these sensitive magnesium lines from interference due to iron or any elements other than magnesium. Upon investigation it was found that three or four sufficiently sensitive lines are available, and of these lines at least three are sufficiently free of interference to be usable.

The procedure described consists of two parts: First, a spectrographic solution method (6) of analyzing metal rods to be used as standards for the control analysis; and, second, a technique for determining magnesium as a part of the customary spectrographic analysis of cast-iron rods or pins.

In the spectrographic solution method for analyzing metal rods for use as standards, iron and magnesium chlorides are sparked from graphite electrodes. Magnesium line 2802.69 Å provides good sensitivity throughout the range 0.01 to 0.10 per cent Mg when magnesium chloride is sparked from graphite electrodes for a period of 12 sec. without pre-exposure. Higher and lower concentrations may be measured by decreasing or increasing the exposure time. The time involved in making an analysis by this method is about an hour, so it is satisfactory for the analysis of standards and occasional samples but too slow for direct foundry control. The solution method is, however, preferable for iron samples of unknown metallurgical history, and in cases where excessive segregation is thought to exist. A precision of ±10 per cent of the magnesium present is attainable.

This elegant method, however, is not directly applicable to the determination of magnesium in cast-iron rod or pin samples simultaneously with the determination of the other elements in cast iron, namely, manganese, silicon, chromium, nickel, molybdenum, etc. These latter determinations require the established procedure employing a 40-sec. exposure with 5-sec. pre-exposure in conjunction with an invariable plate processing technique. The determination of magnesium must fit itself into this pattern. There is no single magnesium line which is entirely adequate under these conditions, but Mg 2795.52 Å can be used for the range 0.005 to 0.025 per cent, and Mg 2852.13 Å for the range 0.020 to 0.15 per cent magnesium. An iron line 2795.54 Å (7) might be expected to interfere with the magnesium line 2795.53 Å, but it has not been detected above background using pure iron samples with this technique. The same observation applies to the weak iron line of 2852.13 Å (7), which, therefore, does not appear to cause appreciable error in determinations involving over 0.020 per cent magnesium. The iron line at 2851.79 Å tends to interfere with the reading of the 2852.13 Å magnesium line, but this is serious only when the magnesium content is below 0.025 per cent.

Combining the solution method of obtaining standards with appropriate lines and working curves from the customary procedure for cast iron provides foundry control for magnesium which is unique in being entirely spectrographic and not dependent on the usual chemically analyzed standards.

Method of Analyzing Standards

Since accurate spectrographic analysis requires the measurement of the minor constituent in respect to the major constituent, it is necessary to provide materials with known magnesium to iron concentration ratios, to be used as a basis for analyzing the metal standards. This is accomplished by preparing separate iron and magnesium solutions of known concentrations and combining them in varying proportions so as to produce the necessary range and number of concentration ratios.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Manufacturing Research Laboratory, Ford Motor Co., Dearborn, Mich.

[2] Quality Control Laboratory, Ford Motor Co., Dearborn, Mich.

[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

Preparation of Synthetic Solutions:

A few grams of magnesium-free iron are dissolved in hydrochloric and nitric acid to provide a solution of 0.05 g. iron content per milliliter. The iron and the reagents should be tested spectroscopically for magnesium contamination before using them. Iron, especially, has been found to be a troublesome source of contamination. Bureau of Standards Standard Sample No. 55b ingot iron has proved satisfactory.

Next, a series of aqueous solutions of magnesium with concentrations ranging from 0.001 to 0.20 per cent are prepared by dissolving weighed amounts of a stable and chemically pure magnesium salt, such as $MgSO_4 \cdot 7H_2O$.

The final synthetic solutions are then prepared by combining constant amounts of the iron solution with the volumes of magnesium solution required to produce the necessary ratios of magnesium to iron. These ratios should be distributed throughout the range of 0.001 to 0.20 per cent magnesium. Since it is necessary that all final solutions contain the same weight of iron per unit volume regardless of the amount of magnesium solution added, dilution to a common final volume is required.

Preparation of Nodular Iron Solution:

In order to obtain spectral densities comparable to those of the synthetic solutions, it is necessary that the nodular iron also be in solution form.

A sufficient weight of nodular iron is dissolved in acid to provide the same weight of iron per milliliter as is contained in each synthetic solution.

Preparation of Electrodes for Sparking:

Since the iron concentration per milliliter has been made the same in both synthesized and nodular iron solutions, it is possible to prepare electrodes from either of these solutions in an identical manner. Graphite electrodes of purity equivalent to National Carbon Co. "Certified" grade are required. A convenient size is $\frac{1}{4}$-in. diameter by 1-in. length. The ends are machined flat and the entire electrode submerged in kerosine, at room temperature, for about 10 min. This impregnation with kerosine later prevents absorption of the aqueous solution. The electrodes are rolled on paper toweling to dry the surface somewhat and are placed on end in a rack.

By means of a micropipet, a 0.03-ml. drop of solution is placed on the flat end of the electrode. Two electrodes are prepared identically for each exposure; both lower and upper electrodes contain the 0.03-ml. drop. The electrode rack with electrodes is then placed in an oven to dry at 110 C. for about 15 min to obtain a dry coating of solid residue on the end of each electrode. The drying temperature is considerably above the flash point of kerosine, so explosion precautions should be observed.

Source Conditions:

The exact type of excitation does not appear to be critical, so almost any spark source could probably be used. It is thought however, that an air-interrupted spark with moderate capacitance is preferable. The following conditions have been used successfully:

Primary voltage to resistor	130 v. a.c.
Primary voltage to transformer	60 v. a.c.
Primary amperes	7.5 amp.
Secondary amperes	7.0 amp.
Auxiliary gap	2 mm.
Analytical gap	3 mm.
Secondary inductance	40 microhenries
Secondary capacitance	0.005 μf
Breaks per half cycle	8 to 10

Spectrograph:

The Bausch & Lomb medium quartz spectrograph is found to have sufficient dispersion for this particular analysis, and an entrance-slit width of 30μ is satisfactory. Eastman Spectrum Analysis No. 1 plates provide high sensitivity for the region used.

Exposures:

A pre-exposure appears to be undesirable, since the greatest sensitivity is obtainable during the first few seconds of sparking. An exposure time of 12 sec. is sufficient for the range 0.01 to 0.10 per cent Mg when electrodes are placed 95 cm. from the entrance slit and the light passes through a 200-mesh screen (approximately 33 per cent transmission) placed between the source and slit. Variation of exposure time appears to be the most desirable way of extending the analytical range.

Plate Processing:

Customary processing is adequate. In this case, it has consisted of:

Developing	1 min. in D-8 at 70 F.
Hardening	20 sec. in saturated aqueous $Cr_2K_2(SO_4)_4 \cdot 24H_2O$
Fixing	1 min. in Eastman X-ray (1:3 dilution)

Microphotometry:

A University of Michigan microphotometer is used to measure Fe 2788.11 Å as the reference line and Mg 2802.69 Å as the element line. Spectra from the series of synthetic solutions are read, and intensity ratios plotted against log concentration, thus forming an analytical curve (Fig. 1). Intensity ratios from spectra of the nodular iron solutions are used to obtain concentrations from the same analytical curve. These analyzed nodular irons can then be used as metal standards in the routine procedure to follow.

Precision:

Table I indicates the degree of precision obtained with this solution method. The average errors of ±10 per cent or less of the amount of magnesium present are considered satisfactory for these low ranges.

Control Method of Analysis

The control method of analyzing nodular iron is designed to fit a regular procedure (3) for cast iron analysis, so that within a few additional seconds magnesium can be determined along with other elements from the same spectrum.

Preparation of Samples:

Samples of the molten metal are poured into iron or molybdenum molds to form $\frac{3}{16}$-in. diameter rod-shaped electrodes. The molds are preferably kept at a temperature sufficient to be completely dry, but not so hot as to prevent fast cooling of the sample rods. With the repeated use of a single mold it has been found that accumulation of heat in the mold causes voids and nonuniform center structure in the rods and makes reproducible analyses impossible. Figure 2 illustrates variations in structure sometimes found in rods obtained under varied sampling conditions. A solid, uniform "white-iron" structure is thought to be desirable for precise analysis.

Sample rods are prepared for sparking by grinding the ends at an angle of 19

TABLE I.—PRECISION AND ACCURACY OF RESULTS OBTAINED BY SOLUTION METHOD OF ANALYSIS.

Magnesium Added, per cent	Found, Plate No. 1	Found, Plate No. 2	Found, Plate No. 3	Found, Plate No. 4	Average Error	Maximum Error
0.01	0.012	0.010	0.011	0.011	0.001	0.002
	0.011	0.009	0.011	0.011		
0.05	0.051	0.052	0.048	0.047	0.003	0.004
	0.049	0.054	0.046	0.047		
0.10	0.100	0.110	0.097	0.105	0.006	0.010
	0.105	0.110	0.092	0.108		

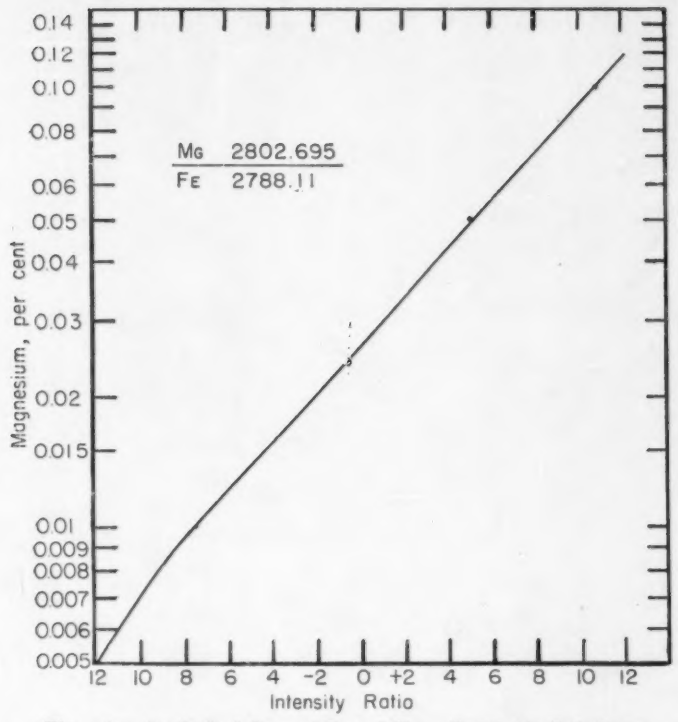


Fig. 1.—Analytical Curved Based Upon Synthetic Solutions.

deg. to form cone-shaped tips. The rods are inserted into spark holders as electrodes and separated by a $\frac{5}{32}$-in. gap.

Source Conditions:

The excitation source employed in this laboratory for routine cast iron analysis may be classified as a high-voltage condensed spark discharged by means of a synchronous mechanical interrupter. Approximate values employed in the excitation circuit are as follows:

Primary supply voltage	220 v. a.c.
Primary resistance	13 ohms
Primary transformer voltage	125 v. a.c.
Primary current	9 amp.
Secondary transformer voltage	18,000 v.
Secondary capacitance	0.005 μf
Secondary inductance	40 microhenries

Constant primary supply voltage is provided by means of a motor generator. A small air stream under 3 psi. pressure "deionizes" the analytical gap.

Spectrograph:

A large Littrow quartz prism spectrograph is adjusted for the photography of wave lengths from 2243 Å to 2940 Å to accommodate the elements customarily determined in cast iron. Several of the most sensitive magnesium lines also fall within this same wave-length range, necessitating no readjustment for the magnesium determination. Entrance-slit width and height are 40μ and $\frac{1}{4}$ in., respectively.

Photographic Exposures and Processing:

The regular photographic procedure for cast iron can be used with no alteration for the determination of magnesium. Following a 5-sec. preexposure, a 40-sec. exposure provides measurable magnesium line densities. Spectrum Analysis No. 1 plates record the spectrum, and development is carried out in D-8 solution for 45 sec. Hardening, fixing, and drying are accomplished by conventional methods.

Microphotometry:

Line densities are measured on a microphotometer of University of Michigan design. In reading the spectrum, Mg 2795.53 Å is found to cover a content range of about 0.005 to 0.025 per cent magnesium when the iron line 2823.27 Å is used as the reference.

TABLE II.—PRECISION OF RESULTS OBTAINED BY CONTROL METHOD OF ANALYSIS AND COMPARISON OF RESULTS OBTAINED BY CONTROL AND SOLUTION METHODS.

Average Result of Seven Control Analyses	Average Deviation of Seven Control Analyses	Maximum Deviation of Seven Control Analyses	Result from Solution Method of Analyses
0.0074	0.0008	0.0013	0.0083
0.021	0.0013	0.003	0.022
0.021	0.0006	0.002	0.017
0.048	0.003	0.006	0.047
0.031	0.0025	0.005	0.030
0.039	0.0017	0.003	0.038
0.056	0.0036	0.005	0.046
0.122	0.0071	0.010	0.125

Another magnesium line accommodates the range from 0.020 to 0.15 per cent magnesium. This line is Mg 2852.13 Å with which the same 2823.27 Å iron reference line is used.

Analytical Curves:

Working curves based on the use of these two magnesium lines are presented in Figs. 3 and 4. Standards used in the construction of the analytical curves for the routine determination of magnesium were obtained by means of large iron molds, providing 25 rods each. The rods were poured from batches of metal having graded amounts of magnesium added. Four rods from each batch were pulverized to provide a suitable sample for the solution method of determining magnesium, described earlier in this paper. The remaining rods are used as working standards, with values based on the solution method of analysis. It has been found advisable to include at least one standard with each group of iron samples analyzed and to duplicate sample determinations from two different pairs of pins for improved accuracy.

Precision:

Table II indicates the degree of precision obtained with the control method. The average deviations of approximately ±10 per cent and less of the amount of magnesium present are adequate for routine control purposes.

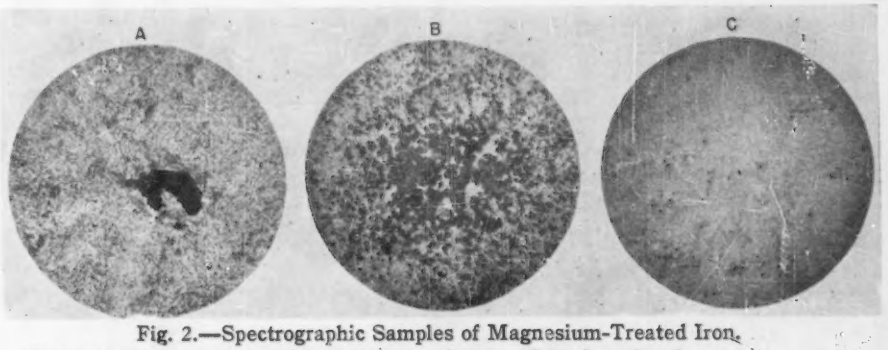


Fig. 2.—Spectrographic Samples of Magnesium-Treated Iron.

Photomicrographs were taken of the center areas of cross-sections of sample rods. *A*, sample which gave low analytical precision presumably because of large center void. *B*, sample which gave low analytical precision presumably because of segregated nonuniform structure. *C*, sample which gave satisfactory analytical precision.

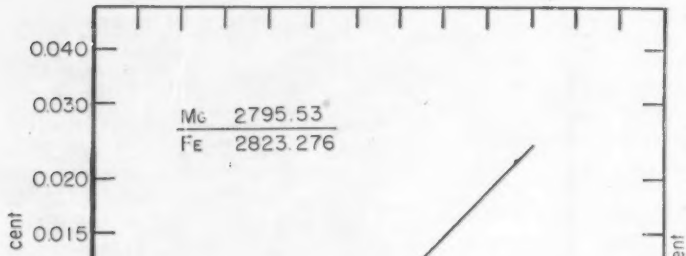


Fig. 3.—Working Curve for Low Magnesium Range.

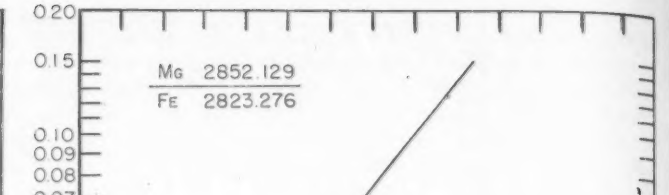


Fig. 4.—Working Curve for High Magnesium Range.

REFERENCES

(1) H. B. Vincent and R. A. Sawyer, "The Spectrograph in the Iron Foundry for Rapid and Accurate Control Analysis," *Journal of Applied Physics*, Vol. 8, pp. 163–173 (1937).

(2) H. B. Vincent, R. A. Sawyer, and A. M. Sampson, "The Spectrograph in the Iron Foundry," *Metals and Alloys*, Vol. 9, pp. 27–32 (1938).

(3) H. B. Vincent and R. A. Sawyer, "Routine Spectroscopic Analysis in the Ford Motor Co. Foundry," *Metal Progress*, Vol. 36, No. 1, pp. 35–39 (1939).

(4) G. W. Zabel and J. Schuch, "Modern Analysis in the Foundry," *Iron Age*, Vol. 145, No. 18, pp. 31–37 (1940).

(5) F. B. Ling, J. McPheat, and J. Arnott, "Spectrographic Analysis of Cast Iron," *Foundry Trade Journal*, Vol. 70, pp. 233–238, 240 (1943).

(6) T. M. Hess, E. L. McLaughlin, and M. A. Ullrey, "Spectrochemical Method of Analyzing Iron for Magnesium," Dowmetal Laboratory Methods Supplement DM109-50-649.

(7) G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables, John Wiley & Sons, Inc., New York, N. Y.

Discussion of Paper on Simplified Preparation of Flat Specimens for Tensile Strength Tests*

G. R. GOHN[1] (*by letter*).—The method of preparing tension test specimens described by Mr. Taxwood would appear to be suitable for use in the case of glass-cloth laminates and similar materials which can only be prepared by cross-milling methods with considerable difficulty. Plastics such as polyethylene, which have a tendency to spring away from the milling cutter, might also fall into the category of materials which would better be prepared by the sander method, but this could only be done at a much slower rate than that suggested by the author, otherwise the specimens would be damaged by overheating. In the case of thin sheet metals and for most plastics we question whether the sander method has any advantage over the cross-milling method originally described by Mr. R. L. Templin[2] or over our own modification of the Templin method as described by Mr. J. R. Townsend.[3]

Specimens sanded to size at the rate suggested by the author would lead to overheating in the case of many metals and most plastics. This overheating might adversely affect the physical properties so that the properties as determined from the test specimens would not be representative of the properties of the basis material. Furthermore we should like to ask the author how it is possible, with the sander method, to obtain the undercutting required at the center of the tension test specimen in order to insure fracture within the gage marks; or the taper and fillets required on cantilever-beam fatigue test specimens. The latter also require such close control of various dimensions that we question whether or not the sander method is adaptable to the preparation of fatigue test specimens.

The final evaluation of any method of preparing tension test specimens such as that suggested by the author should rest not upon the cost of preparation but upon the ability of various laboratories to obtain almost identical values when specimens from the same sheet of material are tested by different laboratories using different machines and testing specimens which have been prepared in their own laboratory. Some data of this type should, we believe, be offered to justify a change in the general preparation of tension or fatigue test specimens.

V. C. TAXWOOD (*author's closure*).—Replying to the question raised by Mr. Gohn, undercutting is possible on the sander for tension specimens by adjusting the table height and using closer stops for the jig travel. However, it has been our experience, as well as that of some others, that undercutting effects no noticeable improvement in the location of the fracture or in resulting data, at least for thermosetting plastics. Undercutting at the test area has therefore been discontinued here.

To date we have experienced no difficulty with overheating. No increase in temperature is evident to the touch at the cut surface immediately after sanding. We realize, however, that overheating could occur with some types of materials. Use of an air blast on the sample, a change of belt speed, or a slower rate of feed would help where overheating is encountered.

* W. C. Taxwood, "Simplified Preparation of Flat Specimens for Tensile Strength Tests," ASTM BULLETIN, No. 157, March 1949, p. 77.

[1] Member of Technical Staff, Bell Telephone Laboratories, Inc., New York, N. Y.

[2] R. L. Templin, "Method for Determining the Tensile Properties of Thin Sheet Metals," *Proceedings*, Am. Soc. Testing Mats., Vol. 27, Part II, p. 235 (1927).

[3] *Ibid;* Discussion, p. 251.

ASTM Bulletins—1949

Subject Index Papers, Reports, and Articles*

A

Abrasion
Improved Single-Unit Schiefer Abrasion Testing Machine—Herbert F. Schiefer, Lawrence E. Crean, and John F. Krasny. No. 159, July, p. 73 (TP133).

Accelerated Testing
Some Observations on the Accelerated A.S.T.M. Life Test for Electrical Heating Wires—Anton deS. Brasunas and Herbert H. Uhlig. No. 161, October, p. 31 (TP175).

Acoustical Materials
Committee C-20 on Acoustical Materials Organizes. No. 157, March, p. 29; No. 159, July, p. 24.

Air Content
Discussion of the Paper on the Pressure Method for Air Content of Mortars. No. 158, May, p. 65 (TP91).

Aircraft Surfaces
Evaluation of Polishes for Use on Aluminum Aircraft Surfaces—Roy A. Machlowitz. No. 156, January, p. 46 (TP8).

Airport Runways
The Preparation of Concrete for Airport Runways—Inge Lyse. No. 161, October, p. 48 (TP192).

Alloys, Non-Ferrous
A Laboratory-Cast Pin Sample for the Spectrographic Analysis of Copper-Base Alloys—E. W. Palmer, J. P. Irwin, and C. C. Fogg. No. 160, September, p. 41 (TP139).
Magnesium Alloys and Applications—John C. McDonald. No. 159, July, p. 67 (TP127).

Aluminum
"Aluminum"—R. L. Templin. No. 158, May, p. 45 (TP71).
Aluminum Condenser and Heat Exchanger Tubes—J. S. Hamilton and J. J. Bowman. No. 159, July, p. 44 (TP104).
Evaluation of Polishes for Use on Aluminum Aircraft Surfaces—Roy A. Machlowitz. No. 156, January, p. 46 (TP8).
A Polarographic Method for the Direct Determination of Aluminum Oxide in Portland Cement—C. L. Ford and Lorrayne LeMar. No. 157, March, p. 66 (TP58).
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 156, January, p. 41 (TP3).

Anhydrite
The Use of Natural Anhydrite in Portland Cement—W. C. Hansen and J. O. Hunt. No. 161, October, p. 50 (TP194); Discussion, p. 57 (TP201).

Annual Address by President
The Progress of A.S.T.M.—R. L. Templin. No. 159, July, p. 43 (TP103).

Annual Meeting Program
Provisional Program. No. 158, May, p. 8.

Asbestos
Creep and Relaxation in Compressed Asbestos Gaskets—F. C. Thorn. No. 160 September, p. 58 (TP156).

Automatic Controlled Temperature
Apparatus for Automatic Uniform Controlled Rise of Temperature—V. C. Taxwood and C. R. Stock. No. 157, March, p. 76 (TP68).

Awards
A.S.T.M. Award of Merit Established. No. 159, July, p. 30.

B

Bleeding
Laboratory Testing of Resistance of Traffic Paint to Bleeding—Fred S. Byerly. No. 160, September, p. 52 (TP150).

Blister Failure
Effect of Temperature on the Rate of Blister Failure of Finishes on Steel in Water Immersion Tests—J. A. Boylan and R. I. Wray. No. 157, March, p. 53 (TP45).

Burning Characteristics
Ignition and Burning Characteristics of Polyester, Phenolic, and Melamine Fibrous Glass Laminates—H. J. Stark. No. 162, December, p. 55 (TP223).

By-laws Change
By-laws Change Proposed on Honorary Memberships. No. 157, March, p. 25.

C

Calorimeter
Simple Calorimeter for Specific Heat Measurements—Roger B. Rice. No. 157, March, p. 72 (TP64).

Cathode Tubes
see **Radio Tubes**

Cement
Important Announcements on Portland Cement Testing. No. 156, January, p. 24.
The Nonevaporable Water Content of Hardened Portland-Cement Paste—Its Significance for Concrete Research and Its Method of Determination—Treval C. Powers. No. 158, May, p. 68 (TP94).
A Polarographic Method for the Direct Determination of Aluminum Oxide in Portland Cement—C. L. Ford and Lorrayne LeMar. No. 157, March, p. 66 (TP58).
Testing Surface Waterproofers—F. O. Anderegg. No. 156, January, p. 71 (TP33); Discussion, p. 76 (TP38).
The Use of Natural Anhydrite in Portland Cement—W. C. Hansen and J. O. Hunt. No. 161, October, p. 50 (TP194); Discussion, p. 57 (TP201).

Cement Flow Table
Improved Flow Table Design Developed by Cement Committee. No. 156, January, p. 24.

Ceramic Whitewares
Scope and Personnel of New Technical Committee on Ceramic Whitewares. No. 157, March, p. 28.

Charpy Impact
see **Impact Testing**

Chromic Acid
Discussion of the Paper on Action of Chromic Acid on Zinc Coatings. No. 156, January, p. 49 (TP11).

Clays
Thixotropic Strength Regain of Clays—Louis Berger and John Gnaedinger. No. 160, September, p. 64 (TP162).

Coatings
The Concept of Organic Coating Hardness—M. H. Switzer. No. 156, January, p. 67 (TP29).

Color Density of Liquids
A Rapid Photoelectric Method for Determination of the Relative Color Density of Liquids—Louis Lykken and John Rae, Jr. No. 160, September, p. 47 (TP145).

Compression Testing
The Use of Natural Anhydrite in Portland Cement—W. C. Hansen and J. O. Hunt. No. 161, October, p. 50 (TP194); Discussion, p. 57 (TP201).
Thixotropic Strength Regain of Clays—Louis Berger and John Gnaedinger. No. 160, September, p. 64 (TP162).

Concrete
The Nonevaporable Water Content of Hardened Portland-Cement Paste—Its Significance for Concrete Research and Its Method of Determination—Treval C. Powers. No. 158, May, p. 68 (TP94).
The Preparation of Concrete for Airport Runways—Inge Lyse. No. 161, October, p. 48 (TP192).

Consistency
A Direct Reading Attachment for the Stormer Viscometer—H. B. Klimper, L. P. Larson, and J. H. Calbeck. No. 161, October, p. 33 (TP177).
A Methodfor the Standardization of Krebs Modified Stormer Viscometers—C. F. Jackson and W. H. Madson. No. 161, October, p. 36 (TP180).

Copper
A Laboratory-Cast Pin Sample for the Spectrographic Analysis of Copper-Base Alloys—E. W. Palmer, J. P. Irwin, and C. C. Fogg. No. 160, September, p. 41 (TP139).
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 156, January, p. 41 (TP3).

Corrosion
Discussion of the Paper on Action of Chromic Acid on Zinc Coatings. No. 156, January, p. 49 (TP11).
Discussion of Paper on Visual Rating of Rusted Steel Specimens. No. 162, December, p. 67 (TP235).
Inter-Society Corrosion Committee Formed. No. 157, March, p. 37.

Creep
Creep and Relaxation in Compressed Asbestos Gaskets—F. C. Thorn. No. 160, September, p. 58 (TP156).

D

Diesel Fuels
The Precision of Fuel Rating, 1942 to 1946—Donald B. Brooks and Robetta B. Cleaton. No. 156, January, p. 56 (TP18).

District Activities
see **Meetings.**

Drying Tests
Panel Discussion on "Practical Aspects of the Testing of Paint and Varnish Products." No. 161, October, p. 39 (TP183).

Durability
A New Durability Test for Marble—D. W. Kessler. No. 159, July, p. 45 (TP105).

E

Elasticity
Discussion of Paper Regarding the Sonic Determination of Modulus of Elasticity Using Round-Section Bars. No. 159, July, p. 49 (TP109).
University of Michigan Summer Session to Emphasize Theory of Elasticity and Structures. No. 158, May, p. 76 (TP102).

Electrical Contacts
Bibliographical Abstracts Issued (Metal Cleaning and Electrical Contacts). No. 160, September, p. 13.

Electrical Heating Wires
Some Observations on the Accelerated A.S.T.M. Life Test for Electrical Heating Wires—Anton deS. Brasunas and Herbert H. Uhlig. No. 161, October, p. 31 (TP175).

Electrical Insultating Material
Electrical Method for Evaluation of Protective Coating as Moisture Barriers—Marion A. Arthur. No. 160, September, p. 57 (TP155).

Elongation
A Method of Determining the Percentage Elongation at Maximum Load in the Tension Test—Paul G. Nelson and Joseph Winlock. No. 156, January, p. 53 (TP15); No. 162, December, p. 46 (TP214).

* Reprints of this Subject and Author Index are available to members on request.

F

Fatigue Testing
Approximate Statistical Method for Fatigue Data—R. E. Peterson. No. 156, January, p. 50 (TP12); Discussion, No. 158, May, p. 62 (TP88); No. 159, July, p. 65 (TP125).
Influence of Type of Machine, Range of Speed, and Specimen Shape on Fatigue Test Data—P. K. Roos, D. C. Lemmon, and J. T. Ransom. No. 158, May, p. 63 (TP89).

Films
Some Notes on the Effect of Testing Machines on the Tensile Properties of Plastic Films—Ladislav Boor. No. 162, December, p. 47 (TP215).

Finances
Financial Highlights—1948. No. 157, March, p. 25.

Flexure Tests
The Significance of the Charpy and Flexure Tests in Evaluating the Impact Resistance of Plastics—H. M. Quackenbos, Jr., J. M. Hill, Jr., and C. E. Staff. No. 159, July, p. 56 (TP116).

Flooring Materials
Floor Waxes, Hard-Surfaced Flooring Materials, and Graphite Under Consideration for New A.S.T.M. Technical Committees. No. 157, March, p. 30.

Fuel Rating
The Precision of Fuel Rating—Donald B. Brooks and Robetta B. Cleaton. No. 156, January, p. 56 (TP18).

G

Galvanized Sheet and Wire
Discussion on the Paper on Action of Chromic Acid on Zinc Coatings. No. 156, January, p. 49 (TP11).

Gaskets
Creep and Relaxation in Compressed Asbestos Gaskets—F. C. Thorn. No. 160, September, p. 58 (TP156).

Gasoline
The Precision of Fuel Rating, 1942 to 1946—Donald B. Brooks and Robetta B. Cleaton. No. 156, January, p. 56 (TP18).

Geiger-Müller Counter Method
A Geiger-Müller Counter Method of Determining Phosphorus in Steels—Ford R. Bryan and George A. Nahstoll. No. 157, March, p. 55 (TP47).

Glass
Ignition and Burning Characteristics of Polyester Phenolic, and Melamine Fibrous Glass Laminates—H. J. Stark. No. 162, December, p. 55 (TP223).

Gold
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 165, January, p. 41 (TP3).

Graphite
Floor Waxes, Hard-Surfaced Flooring Materials, and Graphite Under Consideration for New A.S.T.M. Technical Committees. No. 157, March, p. 30.

H

Hardness Testing
The Concept of Organic Coating Hardness—M. H. Switzer. No. 156, January, p. 67 (TP29).
A History of Hardness Tests Based on Scratch Resistance Measurements—Ernest C. Bernhardt. No. 157, March, p. 49 (TP41).

Heat Exchanger Tubes
Aluminum Condenser and Heat Exchanger Tubes—J. S. Hamilton and J. J. Bowman. No. 159, July, p. 44 (TP104).

Highway Centerlines
A Direct Reading Portable Photoelectric Photometer for Determining Reflectance of Highway Centerlines—John M. Hill and Howard W. Ecker. No. 159, July, p. 69 (TP129).

I

Impact Testing
Impact Testing of Plastics: Elimination of the Toss Factor—Bryce Maxwell and L. F. Rahm. No. 161, October, p. 44 (TP188). Discussion, p. 47 (TP191).
Investigation of Square Sub-sized V-Notched Charpy Specimens—Donald C. Buffum. No. 160, September, p. 45 (TP143).
The Significance of the Charpy and Flexure Tests in Evaluating the Impact Resistance of Plastics—H. M. Quackenbos, Jr., J. M. Hill, Jr., and C. E. Staff. No. 159, July, p. 56 (TP116).

Ignition Characteristics
Ignition and Burning Characteristics of Polyester, Phenolic, and Melamine Fibrous Glass Laminates—H. J. Stark. No. 162, December, p. 55 (TP233).

Industrial Water
Round-Table Discussion on Standards for Water-Borne Wastes. No. 162, December:
Introduction—L. Kermit Herndon, p. 35 (TP203).
Gaging and Sampling of Water-Borne Industrial Wastes—C. F. Hauck, p. 38 (TP206).
Analysis of Water-Borne Industrial Wastes—George D. Beal and S. A. Braley, p. 36 (TP204).
Joint Discussion, p. 43 (TP211).

Insulating Materials
Measurement of the Thermal Transmission of Textile Fabrics—Gerald Winston and Stanley Backer. No. 162, December, p. 62 (TP230).

Insulating Oil
Three Papers in Insulating Oil Symposium. No. 156, January, p. 26.

Iron
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 156, January, p. 41 (TP3).
Spectrographic Methods for Determining Magnesium in Nodular Iron—Ford R. Bryan, G. A. Nahstoll, and H. D. Veldhuis. No. 162, December, p. 69 (TP237).

Izod Impact
see **Impact Testing**

K

Knock Test
The Precision of Fuel Rating, 1942 to 1946—Donald B. Brooks and Robetta B. Cleaton. No. 156, January, p. 56 (TP18).

L

Lead
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 156, January, p. 41 (TP3).

Lime
Nomograms for Obtaining the Compound Composition of Hydrated Limes from the Oxide Analysis—Ernest M. Levin. No. 162, December, p. 58 (TP 226).

M

Magnesium
Magnesium Alloys and Applications—John C. McDonald. No. 159, July, p. 67 (TP127).
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 156, January, p. 41 (TP3).
Spectrographic Methods for Determining Magnesium in Nodular Iron—Ford R. Bryan, G. A. Nahstoll, and H. D. Veldhuis. No. 162, December, p. 69 (TP237).

Marble
A New Durability Test of Marble—D. W. Kessler. No. 159, July, p. 45 (TP105).

Meetings
Committee on Arrangements Appointed for West Coast Meeting. No. 157, March, p. 6.
District Meetings: No. 156, January p. 22; No. 157, March, p. 27; No. 158, May, p. 29; No. 160, September, p. 16; No. 161, October, p. 14; No. 162, December, p. 21.
Fifty-second Annual Meeting. No. 156, January, p. 12; No. 159, July, p. 5.
Los Angeles Air Pollution. No. 156, January, p. 22.
Pacific Area National Meeting. No. 156, January, p. 12; No. 158, May, p. 20; No. 159, July, p. 28; No. 160, September, p. 5; No. 262, December, p. 18.
1949 Spring Meeting. No. 156, January, p. 10; No. 157, March, pp. 7 and 9.
Three Papers in Insulating Oil Symposium. No. 156, January, p. 26.

Metal Cleaning
Application of the Radioactive Tracer Technique to Metal Cleaning—J. C. Harris, R. E. Kamp, and W. H. Yanko. No. 158, May, p. 49 (TP75).
Bibliographical Abstracts Issued (Metal Cleaning and Electrical Contacts). No. 160, September, p. 13.

Metal Polishes
Evaluation of Polishes for Use on Aluminum Aircraft Surfaces—Roy A. Machlowitz. No. 156, January, p. 46 (TP8).

Metal Powders
A Compressibility Test for Metal Powders—F. V. Lenel. No. 158, May, p. 52 (TP78).

Moisture Barriers
Electrical Method for Evaluation of Protective Coating as Moisture Barriers—Marion A. Arthur. No. 160, September, p. 57 (TP155).

Mortars
Discussion of the Paper on the Pressure Method for Air Content of Mortars. No. 158, May, p. 65 (TP91).

N

Naval Ordnance Laboratory
Naval Ordnance Laboratory—White Oak. No. 158, May, p. 34.

Non-Destructive Testing
Spectrographic Methods for Determining Magnesium in Nodular Iron—Ford R. Bryan, G. A. Nahstoll, and H. D. Veldhuis. No. 162, December, p. 69 (TP237).

Nomograms
Nomograms for Obtaining the Compound Composition of Hydrated Limes from the Oxide Analysis—Ernest M. Levin. No. 162, December, p. 58 (TP226).

O

Organic Coatings
The Concept of Organic Coating Hardness—M. H. Switzer. No. 156, January, p. 67 (TP29).

Oxide Analysis
Nomograms for Obtaining the Compound Composition of Hydrated Limes from the Oxide Analysis—Ernest M. Levin. No. 162, December, p. 58 (TP226).

P

Pacific Area National Meeting
Pacific Area National Meeting. No. 156, January, p. 12; No. 158, May, p. 20; No. 159, July, p. 28; No. 160, September, p. 5; No. 162, December, p. 18.

Packages
Performance Testing of Packages in Relation to Handling and Shipping—Julian Harrison Toulouse. No. 159, July, p. 50 (TP110).

Paint
The Concept of Organic Coating Hardness—M. H. Switzer. No. 156, January, p. 67 (TP29).
A Direct Reading Attachment for the Stormer Viscometer—H. B. Klimper, L. P. Larson, and J. H. Calbeck. No. 161, October, p. 33 (TP177).

Effect of Temperature on the Rate of Blister Failure of Finishes on Steel in Water Immersion Tests—J. A. Boylan and R. I. Wray. No. 157, March, p. 53 (TP45).
Federation Activities on Paint. No. 157, March, p. 24.
Important New and Revised Standards on Steel, Paint and Paint Materials, Plastics, and Non-Ferrous Metals. No. 158, May, p. 22.
Laboratory Testing of Resistance of Traffic Paint to Bleeding—Fred S. Byerly. No. 160, September, p. 52 (TP150).
Panel Discussion on "Practical Aspects of the Testing of Paint and Varnish Products." No. 161, October, p. 39 (TP183).

Photoelectric Method
A Rapid Photoelectric Method for Determination of the Relative Color Density of Liquids—Louis Lykken and John Rae, Jr. No. 160, September, p. 47 (TP145).

Photoelectric Photometer
A Direct Reading Portable Photoelectric Photometer for Determining Reflectance of Highway Centerlines—John M. Hill and Howard W. Ecker. No. 159, July, p. 69 (TP129).

Phosphorus
A Geiger-Müller Counter Method of Determining Phosphorus in Steels—Ford R. Bryan and George A. Nahstoll. No. 157, March, p. 55 (TP47).

Plastics
Ignition and Burning Characteristics of Polyester, Phenolic, and Melamine Fibrous Glass Laminates—H. J. Stark. No. 162, December, p. 55 (TP223).
Impact Testing of Plastics: Elimination of the Toss Factor—Bryce Maxwell and L. F. Rahm. No. 161, October, p. 44 (TP188); Discussion, p. 47 (TP191).
Important New and Revised Standards on Steel, Paint and Paint Materials, Plastics, and Non-Ferrous Metals. No. 158, May, p. 22.
The Significance of the Charpy and Flexure Tests in Evaluating the Impact Resistance of Plastics—H. M. Quackenbos, Jr., J. M. Hill, Jr., and C. E. Staff. No. 159, July, p. 56 (TP116).
Some Notes on the Effect of Testing Machines on the Tensile Properties of Plastic Films—Ladislav Boor. No. 162, December, p. 47 (TP215).

Plastic Films
Method for Weight Loss of Plastic Films and Sheets on Heating—Maurice E. Marks. No. 159, July, p. 53 (TP113).

Polishes
Evaluation of Polishes for Use on Aluminum Aircraft Surfaces—Roy A. Machlowitz. No. 156, January, p. 46 (TP8).

Porcelain Enamel
News of New Committees on Acoustical Materials and Porcelain Enamel. No. 157, March, p. 29; also No. 160, September, p. 30.

Powder Metallurgy
A Compressibility Test for Metal Powders—F. V. Lenel. No. 158, May, p. 52 (TP78).

Presentation of Data
Approximate Statistical Method for Fatigue Data—R. E. Peterson. No. 156, January, p. 50 (TP12). Discussion, No. 158, May, p. 62 (TP88); No. 159, July, p. 65 (TP125).

Presidents Address and Talks
Aluminum—H. L. Templin. No. 158, May, p. 45 (TP71).
The Progress of A.S.T.M. No. 159, July, p. 43 (TP103).

Pressure Method
Discussion of the Paper on the Pressure Method for Air Content of Mortars. No. 158, May, p. 65 (TP91).

Programs
Provisional Program. No. 158, May, p. 8.

Protective Coatings
Electrical Method for Evaluation of Protective Coatings as Moisture Barriers—Marion A. Arthur. No. 160, September, p. 57 (TP155).

Publications
Extensive Publication Schedule for 1949–1950. No. 160, September, p. 11; No. 161, October, p. 10.

R

Radio Tubes
Radio Tube Cathode Studies to Continue Intensively; Results Briefed. No. 156, January, p. 23.

Radioactive Tracer Technique
Application of the Radioactive Tracer Technique to Metal Cleaning—J. C. Harris, R. E. Kamp, and W. H. Yanko. No. 158, May, p. 49 (TP75).

Rayon
The Definition of Rayon. No. 156, January, p. 29.

Reflectance
A Direct Reading Portable Photoelectric Photometer for Determining Reflectance of Highway Centerlines—John M. Hill and Howard W. Ecker. No. 159, July, p. 69 (TP129).

Rubber
Study of A.S.T.M. Tentative Stiffness Test as Applied to Rubber—Dietrich G. Stechert. No. 157, March, p. 61 (TP53).
Symposium on Aging of Rubbers Features Spring Meeting. No. 157, March, p. 7.

Rust
Discussion of Paper on Visual Rating of Rusted Steel Specimens. No. 162, December, p. 67 (TP235).

S

Scratch Resistance
A History of Hardness Tests Based on Scratch Resistance Measurements—Ernest C. Bernhardt. No. 157, March, p. 49 (TP41).

Screw Threads
Unification of Screw Thread Standards—A Major Accomplishment. No. 157, March, p. 38.

Setting Time
The Use of Natural Anhydrite in Portland Cement—W. C. Hansen and J. O. Hunt. No. 161, October, p. 50 (TP194); Discussion, p. 57 (TP201).

Shipping Containers
Performance Testing of Packages in Relation to Handling and Shipping—Julian Harrison Toulouse. No. 159, July, p. 50 (TP110).

Simulated Service Testing
Performance Testing of Packages in Relation to Handling and Shipping—Julian Harrison Toulouse. No. 159, July, p. 50 (TP110).
Significance of Naval Testing—Ellsworth P. Seaman. No. 160, September, p. 62 (TP160).

Soils
Thixotropic Strength Regain of Clays—Louis Berger and John Gnaedinger. No. 160, September, p. 64 (TP162).

Sonic Testing
Discussion of the Paper Regarding the Sonic Determination of Modulus of Elasticity Using Round-Section Bars. No. 159, July, p. 49 (TP109).

Spectrographic Analysis
A Laboratory-Cast Pin Sample for the Spectrographic Analysis of Copper-Base Alloys—E. W. Palmer, J. P. Irwin, and C. C. Fogg. No. 160, September, p. 41 (TP139).
Nomenclature in Applied Spectroscopy to Be Covered by Joint Committee. No. 157, March, p. 30.
Spectrographic Methods for Determining Magnesium in Nodular Iron—Ford R. Bryan, G. A. Nahstoll, and H. D. Veldhuis. No. 162, December, p. 69 (TP237).

Speed of Testing
Effect of Speed of Testing on the Tensile Properties of Austenitic Stainless Steel Sheets—R. H. Heyer. No. 158, May, p. 57 (TP83). Discussion, No. 162, December, p. 53 (TP221).
Speed of Testing—F. G. Tatnall. No. 161, October, p. 23 (TP167).

Standards and Standardization
Actions by Standards Committee Affect Plastics, Electronic Devices, Glass Containers, and Asbestos. No. 160, September, p. 10.
A.S.T.M. Specifications Used for Steel for Petrolcum. No. 157, March, p. 21.
A.S.T.M. Standards in Housing Requirements. No. 158, May, p. 27.
Color Transparency Standards for the Visual Classification of Natural Muscovite Block Mica Now Available. No. 158, May, p. 30.
How An A.S.T.M. Standard Gets That Way. No. 156, January, p. 20.
Important New and Revised Standards on Steel, Paint and Paint Materials, Plastics, and Non-Ferrous Metals. No. 158, May, p. 22.
List of New and Revised Tentatives with Serial Designations. No. 159, July, p. 27.
Many New Specifications and Tests Accepted. No. 161, October, p. 5.
A Method for the Standardization of Krebs Modified Stormer Viscometers—C. F. Jackson and W. H. Madson. No. 161, October, p. 36 (TP180).
1948 a Noteable Year for Advancing A.S.T.M. Work in Materials. No. 156, January, p. 5.
Outline of Standardization Procedure of the A.S.T.M. January, p. 21.
Philosophy of Specifications—L. S. Reid and W. R. Willets. No. 156, January, p. 39 (TP1).
Recent Actions on Standards (Steel, Aluminum, Glass, Roofing Materials, Electrical Insulating Materials). No. 156, January, p. 14.
Recommended Editorial Revisions in Tolerances in Dimensions of the Blaine Air-Permeability Apparatus for Determining the Fineness of Portland Cement. No. 156, January, p. 25.
The Standardization and Simplification of Steel Products—L. H. Winker and J. G. Morrow. No. 157, March, p. 20.
Standards Widely Used in Specifying and Purchasing Materials in Production and Distribution; Also in Spearheading Research. No. 160, September, p. 14; No. 161, October, p. 13; No. 162, December, p. 19.
Testing and the Federal Trade Commission. No. 157, March, p. 22.
Unification of Screw Thread Standards—A Major Accomplishment. No. 157 March, p. 38.
What Good Are Standards? (Abstracts of papers presented at an A.S.A. Meeting.) No. 157, March, p. 13.

Statistical Analysis
Approximate Statistical Method for Fatigue Data—R. E. Peterson. No. 156, January, p. 50 (TP12); Discussion, No. 158, May, p. 62 (TP88); No. 159, July, p. 65 (TP125).

Steel
Effect of Speed of Testing on the Tensile Properties of Austenitic Stainless Steel Sheets—R. H. Heyer. No. 158, May, p. 57 (TP83). Discussion, No. 162, December, p. 53 (TP221).
Effect of Temperature on the Rate of Blister Failure of Finishes on Steel in Water Immersion Tests—J. A. Boylan and R. I. Wray. No. 157, March, p. 53 (TP45).
Discussion of Paper on Visual Rating of Rusted Steel Specimens. No. 162, December, p. 67 (TP235).
A Geiger-Müller Counter Method of Determining Phosphorus in Steels—Ford R. Bryan and George A. Nahstoll. No. 157, March, p. 55 (TP47).
Important New and Revised Standards on Steel, Paint and Paint Materials, Plastics, and Non-Ferrous Metals. No. 158, May, p. 22.
A Method of Determining the Percentage Elongation at Maximum Load in the Tension Test—Paul G. Nelson and Joseph Winlock. No. 156, January, p.

Steels (*continued*)
53 (TP15); No. 162, December, p. 46 (TP215).
The Standardization and Simplification of Steel Products—L. H. Winkler and J. G. Morrow. No. 157, p. 20.

Stiffness Test
Study of A.S.T.M. Tentative Stiffness Test as Applied to Rubber—Dietrich G. Stechert. No. 157, March, p. 61 (TP-53).

Strain Gages
Strain Gages for Large Plastic Strains and Combined Stresses—Joseph Marin. No. 161, October, p. 28 (TP172).

T

Tension Testing
A Method of Determining the Percentage Elongation at Maximum Load in the Tension Test—Paul G. Nelson and Joseph Winlock. No. 156, January, p. 53 (TP15); No. 162, December, p. 46 (TP214).
Effect of Speed of Testing on the Tensile Properties of Austenitic Stainless Steel Sheets—R. H. Heyer. No. 158, May, p. 57 (TP83). Discussion, No. 162, December, p. 53 (TP221).
Simplified Preparation of Flat Specimens for Tensile Strength Tests—V. C. Taxwood. No. 157, March, p. 77 (TP69). Discussion, No. 162, December, p. 72 (TP240).
Some Notes on the Effect of Testing Machines on the Tensile Properties of Plastic Films—Ladislav Boor. No. 162, December, p. 47 (TP215).
Strain Gages for Large Plastic Strains and Combined Stresses—Joseph Marin. No. 161, October, p. 28 (TP172).
Tension Testing of Fabrics. No. 156, January, p. 27.

Test Specimen
Investigation of Square Sub-sized V-Notched Charpy Specimens—Donald C. Buffum. No. 160, September, p. 45 (TP143).
Simplified Preparation of Flat Specimens for Tensile Strength Tests—V. C. Taxwood. No. 157, March, p. 77 (TP69). Discussion, No. 162, December, p. 72 (TP240).

Textiles
Accelerated Aging Tests Devised and Combined to Simulate Use of Fabrics. No. 158, May, p. 34.
Improved Single-Unit Schiefer Abrasion Testing Machine—Herbert F. Schiefer, Lawrence E. Crean, and John F. Krasny. No. 159, July, p. 73 (TP133).
Measurement of the Thermal Transmission of Textile Fabrics—Gerald Winston and Stanley Backer. No. 162, December, p. 62 (TP230).
Report on ISO Conference on Textiles. No. 156, January, p. 18.
Textiles on The International Front. No. 156, January, p, 18.
A Universal Yarn Numbering System. No. 156, January, p. 28.

Thermal Insulation
Measurement of the Thermal Transmission of Textile Fabrics—Gerald Winston and Stanley Backer. No. 162, December, p. 62 (TP230).

Thixotropic Strength
Thixotropic Strength Regain of Clays—Louis Berger and John Gnaedinger. No. 160, September, p. 64 (TP162).

Tin
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 156, January, p. 41 (TP3).

Titanium
Recent Milestones in Metals and Minerals—John D. Sullivan. No. 156, January, p. 41 (TP3).

Torsion Testing
Strain Gages for Large Plastic Strains and Combined Stresses—Joseph Marin. No. 161, October, p. 28 (TP172).
A Torsion Testing Machine of 2,000,000 Inch-Pound Capacity—F. K. Chang, K. Endre Knudsen, and Bruce G. Johnston. No. 160, September, p. 49 (TP147).

Toss Factor
Impact Testing of Plastics: Elimination of the Toss Factor—Bryce Maxwell and L. F. Rahm. No. 161, October, p. 44 (TP188); Discussion, p. 47 (TP191).

Traffic Paint
Laboratory Testing of Resistance of Traffic Paint to Bleeding—Fred S. Byerly. No. 160, September, p. 52 (TP150).
A Direct Reading Portable Photoelectric Photometer for Determining Reflectance of Highway Centerlines—John M. Hill and Howard W. Ecker. No. 159, July, p. 69 (TP129)

U

Universal Yarn Numbering System.
A Universal Yarn Numbering System. No. 156, January, p. 28.

V

Varnish
Panel Discussion of "Practical Aspects of the Testing of Paint and Varnish Products." No. 161, October, p. 39 (TP-183).

Viscosity
A Direct Reading Attachment for the Stormer Viscometer—H. B. Klimper, L. P. Larson, and J. H. Calbeck. No. 161, October, p. 33 (TP177).
A Method for the Standardization of Krebs Modified Stormer Viscometers—C. F. Jackson and W. H. Madson. No. 161, October, p. 36 (TP180).

Volatility
Method for Weight Loss of Plastic Films and Sheets on Heating—Maurice E. Marks. No. 159, July, p. 53 (TP113).

W

Water
Round-Table Discussion on Standards for Water-Borne Wastes. No. 162, December:
Introduction—L. Kermit Herndon, p. 35 (TP203).
Gaging and Sampling of Water-Borne Industrial Wastes—C. F. Hauck, p. 38 (TP206).
Analysis of Water-Borne Industrial Wastes—George D. Beal and S. A. Braley, p. 36 (TP204).
Joint Discussion, p. 43 (TP211).

Water Content
The Nonevaporable Water Content of Hardened Portland-Cement Paste—Its Significance for Concrete Research and Its Method of Determination—Treval C. Powers. No. 158, May, p. 68 (TP-94).

Waterproofing
Testing Surface Waterproofers—F. O. Anderegg. No. 156, January, p. 71 (TP33); Discussion, p. 76 (TP38).
Electrical Method for Evaluation of Protective Coatings as Moisture Barriers—Marion A. Arthur. No. 160, p. 57 (TP155).

Waxes
Floor Waxes, Hard-Surfaced Flooring Materials, and Graphite Under Consideration for New A.S.T.M. Technical Committees. No. 157, March, p. 30.

Weathering
A New Durability Test for Marble—D. W. Kessler. No. 159, July, p. 45 (TP105).

Weight Loss
Method for Weight Loss of Plastic Films and Sheets on Heating—Maurice E. Marks. No. 159, July, p. 53 (TP113).

Wire
Some Observations on the Accelerated A.S.T.M. Life Test for Electrical Heating Wires—Anton deS. Brasunas and Herbert H. Uhlig. No. 161, October, p. 31 (TP175).

Wood Poles
Program for Testing Wood Poles to Determine Allowable Fiber Stresses—L. G. Smith. No. 160, September, p. 32.

Wool
A Report on the International Wool Conference in Amsterdam, Holland. No. 156, January, p. 31.

X

X-ray Diffraction Data
Revised Card Index File of X-ray Diffraction Data for Identification of Crystalline Materials to Be Issued Soon. No. 160, September, p. 18.

Y

Yarn Numbering System
A Universal Yarn Numbering System. No. 156, January, p. 28.

Z

Zinc Coatings
Discussion of the Paper on Action of Chromic Acid on Zinc Coatings. No. 156, January, p. 49 (TP11).

Index to Authors of Technical Papers

1949 ASTM Bulletins

A

Anderegg, F. O.
Testing Surface Waterproofers, No. 156, January, p. 71 (TP33).

Arthur, Marion A.
Electrical Method for Evaluation of Protective Coatings as Moisture Barriers, No. 160, September, p. 57 (TP155).

B

Backer, Stanley
See Winston, Gerald.

Beal, George D.
Analysis of Water-Borne Industrial Wastes—Round Table Discussion on Standards for Water-Borne Wastes, No. 162, December, p. 36 (TP204).

Berger, Louis
Thixotropic Strength Regain of Clays, No. 160, September, p. 64 (TP162).

Bernhardt, Ernest C.
A History of Hardness Tests Based on Scratch Resistance Measurements, No. 157, March, p. 49 (TP41).

Boor, Ladislav
Some Notes on the Effect of Testing Machines on the Tensile Properties of Plastic Films, No. 162, December, p. 47 (TP215).

Bowman, J. J.
See Hamilton, J. S.

Boylan, J. A.
Effect of Temperature on the Rate of Blister Failure of Finishes on Steel in Water Immersion Tests, No. 157, March, p. 53 (TP45).

Brasunas, Anton deS.
Some Observations on the Accelerated A.S.T.M. Life Test for Electrical Heating Wires, No. 161, October, p. 31 (TP175).

Braley, S. A.
See Beal, George D.

Brooks, Donald B.
The Precision of Fuel Rating, 1942 to 1946, No. 156, January, p. 56 (TP18).

Bryan, Ford R.
A Geiger-Müller Counter Method of Determining Phosphorus in Steels, No. 157, March, p. 55 (TP47).
Spectrographic Methods for Determining

Magnesium in Nodular Iron, No. 162, December, p. 69 (TP237).

Buffum, Donald C.
Investigation of Square Sub-sized V-Notched Charpy Specimens, No. 160, September, p. 45 (TP143).

Byerly, Fred S.
Laboratory Testing of Resistance of Traffic Paint to Bleeding, No. 160, September, p. 52 (TP150).

C

Calbeck, J. H.
See Klimper, H. B.

Chang, F. K.
A Torsion Testing Machine of 2,000,000 Inch-Pound Capacity, No. 160, September, p. 49 (TP147).

Cleaton, Robetta B.
See Brooks, Donald B.

Crean, Lawrence E.
See Schiefer, Herbert F.

E

Ecker, Howard W.
See Hill, John M.

F

Fogg, C. C.
See Palmer, E. W.

Ford, C. L.
A Polarographic Method for the Direct Determination of Aluminum Oxide in Portland Cement, No. 157, March, p. 66 (TP58).

G

Gnaedinger, John
See Berger, Louis

H

Hamilton, J. S.
Aluminum Condenser and Heat Exchanger Tubes, No. 159, July, p. 44 (TP104).

Hansen, W. C.
The Use of Natural Anhydrite in Portland Cement, No. 161, October, p. 50 (TP194).

Harris, J. C.
Application of the Radioactive Tracer Technique to Metal Cleaning, No. 158, May, p. 49 (TP75).

Hauck, C. F.
Gaging and Sampling of Water-Borne Industrial Wastes—Round-Table Discussion on Standards for Water-Borne Wastes, No. 162, December, p. 38 (TP206).

Herndon, L. Kermit
Round-Table Discussion on Standards for Water-Borne Wastes—Introduction No. 162, December, p. 35 (TP203).

Heyer, R. H.
Effect of Speed of Testing on the Tensile Properties of Austenitic Stainless Steel Sheets, No. 158, May, p. 57 (TP83).

Hill, J. M., Jr.
See Quackenbos, H. M., Jr.

Hill, John M.
A Direct Reading Portable Photoelectric Photometer for Determining Reflectance of Highway Centerlines, No. 159, July, p. 69 (TP129).

Hunt, J. O.
See Hansen, W. C.

I

Irwin, J. P.
See Palmer, E. W.

J

Jackson, C. F.
A Method for the Standardization of Krebs Modified Stormer Viscometers, No. 161, October, p. 36 (TP180).

Johnston, Bruce G.
See Chang, F. K.

K

Kamp, R. E.
See Harris, J. C.

Kessler, D. W.
A New Durability Test for Marble, No. 159, July, p. 45 (TP105).

Klimper, H. B.
A Direct Reading Attachment for the Stormer Viscometer, No. 161, October, p. 33 (TP177).

Knudsen, K. Endre
See Chang, F. K.

Krasny, John F.
See Schiefer, Herbert F.

L

Larson, L. P.
See Klimper, H. B.

Le Mar, Lorrayne
See Ford, C. L.

Lemmon, D. C.
See Roos, P. K.

Lenel, F. V.
A Compressibility Test for Metal Powders, No. 158, May, p. 52 (TP78).

Levin, Ernest M.
Nomograms for Obtaining the Compound Composition of Hydrated Limes from the Oxide Analysis, No. 162, December, p. 58 (TP226).

Lykken, Louis, Jr.
A Rapid Photoelectric Method for Determination of the Relative Color Density of Liquids, No. 160, September, p. 47 (TP145).

Lyse, Inge
The Preparation of Concrete for Airport Runways, No. 161, October, p. 48 (TP192).

M

Machlowitz, Roy A.
Evaluation of Polishes for Use on Aluminum Aircraft Surfaces, No. 156, January, p. 46 (TP8).

Madson, W. H.
See Jackson, C. F.

Marin, Joseph
Strain Gages for Large Plastic Strains and Combined Stresses, No. 161, October, p. 28 (TP172).

Marks, Maurice E.
Method for Weight Loss of Plastic Films and Sheets on Heating, No. 159, July, p. 53 (TP113).

Maxwell, Bryce
Impact Testing of Plastics: Elimination of the Toss Factor, No. 161, October, p. 44 (TP188).

McDonald, John C.
Magnesium Alloys and Applications, No. 159, July, p. 67 (TP127).

N

Nahstoll, G. A.
See Bryan, Ford R. (TP237).

Nelson, Paul G.
A Method Of Determining the Percentage Elongation at Maximum Load in the Tension Test, No. 156, January, p. 53 (TP15).

P

Palmer, E. W.
A Laboratory-Cast Pin Sample for the Spectrographic Analysis of Copper-Base Alloys, No. 160, September, p. 41 (TP139).

Peterson, R. E.
Approximate Statistical Method for Fatigue Data, No. 156, January, p. 50 (TP12).

Powers, Treval C.
The Nonevaporable Water Content of Hardened Portland-Cement Paste—Its Significance for Concrete Research and Its Method of Determination, No. 158, May, p. 68 (TP94).

Q

Quackenbos, H. M., Jr.
The Significance of the Charpy and Flexure Tests in Evaluating the Impact Resistance of Plastics, No. 159, July, p. 56 (TP116).

R

Rae, John, Jr.
See Lykken, Louis

Rahm, L. F.
See Maxwell, Bryce

Ransom, J. T.
See Roos, P. K.

Reid, L. S.
Philosophy of Specifications, No. 156, January, p. 39 (TP1).

Rice, Roger B.
Simple Calorimeter for Specific Heat Measurements, No. 157, March, p. 72 (TP64).

Roos, P. K.
Influence of Type of Machine, Range of Speed, and Specimen Shape on Fatigue Test Data, No. 158, May, p. 63 (TP89).

S

Schiefer, Herbert F.
Improved Single-Unit Schiefer Abrasion Testing Machine, No. 159, July, p. 73 (TP133).

Seaman, Ellsworth F.
Significance of Naval Testing, No. 160, September, p. 62 (TP160).

Smith, L. G.
Testing Wood Poles to Determine Fiber Allowable Stress, No. 160, September, p. 32

Staff, C. E.
See Quackenbos, H. M., Jr.

Stark, H. J.
Ignition and Burning Characteristics of Polyester, Phenolic, and Melamine Fibrous Glass Laminates, No. 162, December, p. 55 (TP223).

Stechert, Dietrich G.
Study of A.S.T.M. Tentative Stiffness Test as Applied to Rubber, No. 157, March, p. 61 (TP53).

Stock, C. R.
See Taxwood, V. C. (TP68).

Sullivan, John D.
Recent Milestones in Metals and Minerals, No. 156, January, p. 41 (TP3).

Switzer, M. H.
The Concept of Organic Coating Hardness, No. 156, January, p. 67 (TP 29).

T

Tatnall, F. G.
Speed of Testing, No. 161, October, p. 23 (TP167).

Taxwood, V. C.
Apparatus for Automatic Uniform Controlled Rise of Temperature, No. 157, March, p. 76 (TP68).
Simplified Preparation of Flat Specimens for Tensile Strength Tests, No. 157, March, p. 77 (TP69).

Templin, R. L.
Aluminum, No. 158, May, p. 45 (TP71).
The Progress of A.S.T.M., No. 159, July, p. 43 (TP103).

Thorn, F. C.
Creep and Relaxation in Compressed Asbestos Gaskets, No. 160, September, p. 58 (TP156).

Toulouse, Julian Harrison
Performance Testing of Packages in Relation to Handling and Shipping, No. 159 July, p. 50 (TP110).

U

Uhlig, Herbert H.
See Brasunas, Anton deS.

V

Veldhuis, H. D.
See Bryan, Ford R. (TP237).

W

Willets, W. R.
See Reid, L. S.

Winlock, Joseph
See Nelson, Paul G.

Winston, Gerald
Measurement of the Thermal Transmission of Textile Fabrics, No. 162, December, p. 62 (TP230).

Wray, R. I.
See Boylan, J. A.

Y

Yanko, W. H.
See Harris, J. C.

Annual Report of the National Bureau of Standards for 1948

Announcement of New Publication:

A SUMMARY of investigations in the physical sciences carried on at the National Bureau of Standards during the fiscal year 1948 is contained in a 272-page illustrated booklet recently published. Included projects are research on resin-bonded papers, investigations of automotive antifreezes, a study of the properties of matter at very low temperatures, development of high-octane aviation gasoline, and research on housing problems—particularly the problem of applying engineering principles to structural design.

This Annual Report of the National Bureau of Standards is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at a cost of 25 cents a copy. The text of this report is also included in the 36th Annual Report of the Secretary of Commerce.

Impregnation of Leather with Natural Rubber

NATURAL rubber greatly improves the durability of leather in a new treating process developed at the National Bureau of Standards. Through the impregnation of leather with natural rubber, Bureau scientists have been able to increase the abrasion and water resistance so that substandard leather—such as "belly-cuts" from steer hides—may be used commercially. Preliminary results from service tests of rubber-treated soles indicate a definite improvement in wearing qualities over untreated leather soles.

The impregnation is accomplished by simple immersion of the naturally porous leather in a solution of natural rubber. Solutions have been made from gutta-percha gum, Hevea (best results), and Castilloa rubber.

In the waterproofness test, the flexing of a sole in walking on a wet surface is simulated by a specially designed machine which periodically bends and presses the leather specimens against a wet sponge. The time, or the number of bending cycles, required for water to penetrate a specimen is taken as a measure of its resistance to water. The dynamic tests show that water transmission and absorption of rubber-treated leather are only 50 per cent as much as untreated control specimens.

Comparative tests showed that the abrasion resistance of vegetable-tanned crust leather is improved from 50 to 100 per cent, depending on the type of rubber treatment used. But as laboratory tests are an indication but not a quantitative measure of wear in service, larger samples of leather will have to be treated before they can be given extended service tests.

Fourth International Electrodeposition Conference

THE 37th Annual Convention of the American Electroplaters' Society which is to be held June 11 to 15, 1950, at the Hotel Statler, Boston, Mass., is also to be featured as the Fourth International Electrodeposition Conference with the collaboration of the Electrodepositors' Technical Society of England.

Inquiries regarding reservations and details of the convention may be obtained by writing to the Convention Committee Chairman, Manson Glover, 376 Washington St., Malden, Mass., or to the Society's Headquarters, P. O. Box 168, Jenkintown, Pa.

Strength of Materials

J. P. Den Hartog

THIS textbook by Mr. Den Hartog, Professor of Mechanical Engineering, Massachusetts Institute of Technology, is designed for use in a first course in Strength of Materials for engineering students.

The book is written in a descriptive style, and contains many practical examples. Each article starts with general theory, and then presents the practical examples of the theory. There are 350 problems, complete with answers, at the end of the text, indexed to the section to which they apply

Special features of this new text include:

1. The method of repeated application of cantilever formulas has been stressed in beam problems in preference to the area-moment method.
2. The Mohr's circle method is treated fully, not only for stresses as usual, but also for the moments of inertia and for strains.
3. The book covers the theory of the center of shear in an elementary manner and discusses photoelasticity and electric strain gages.

Contents of the book include chapters on:

Tension; Torsion; Bending; Compound Stresses; Deflections of Beams; Special Beam Problems; Cylinders and Curved Bars; The Energy Method; Buckling; Experimental Elasticity; Problems; Answers to Problems; List of Formulas; Index.

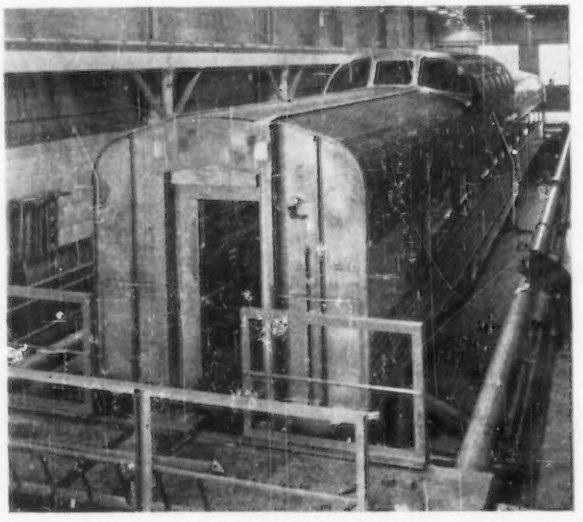
This 323-page book may be obtained at a cost of $4 per copy from the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y.

Two Million Pound Squeeze—Simulated Service Tests

THIS horizontal, hydraulic, compression testing machine at the E. G. Budd Co., Philadelphia, Pa., is performing all of the tests on full-scale cars required by the American Assn. of Railroads—determination of sideswiping strength, vertical, lateral, and longitudinal roof strength and rigidity; floor strength and elastic properties under live load; strength and rigidity of side structures and vital subassemblies such as the vestibule floor assembly.

A car is run onto an elevator and raised to any position between the power and reaction heads of the ram joined by large adjustable tension rods, so that loads may be centered on any desired point. Eccentric heads can be applied by means of a lateral traversing mechanism and lateral or vertical loads may be applied by auxiliary hydraulic jacks and a load maintainer.

Detailed strength and elastic behavior date is obtained through the use of 480 autographically recording strain gages, Magnaflux stress coat equipment, and direct-inking oscillographs.



A 95-ft. Railway Car Can Be Accommodated by This Budd-designed, Horizontal, Hydraulic Testing Machine.